The Welding Engineer

Edited by L. B. Mackenzie

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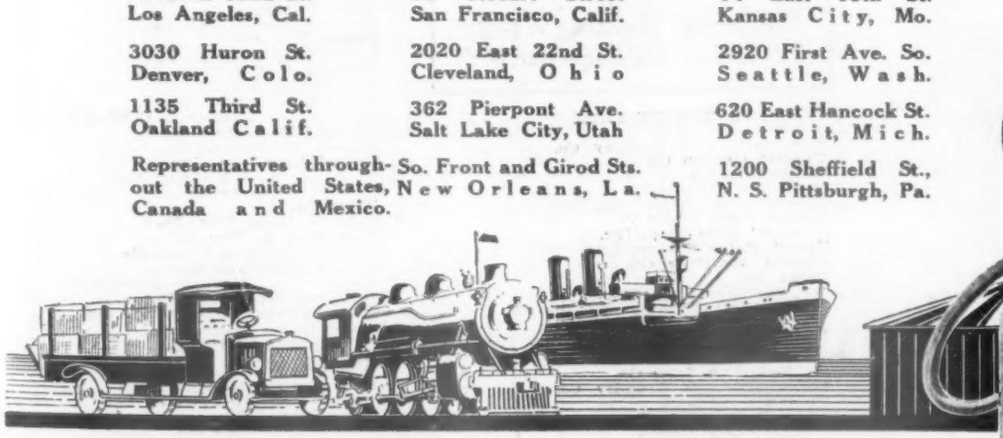

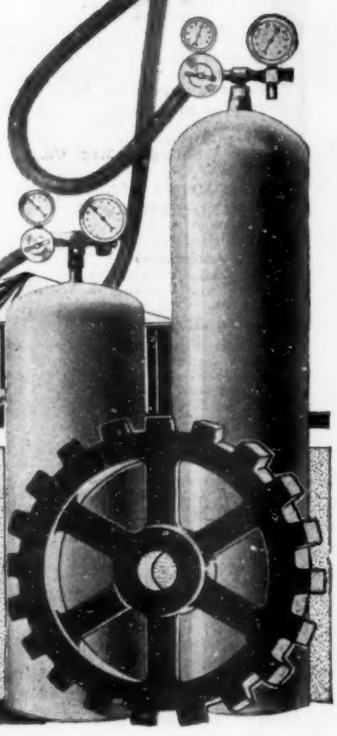

WELDING
PUROX
CUTTING

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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International Oxygen Co.
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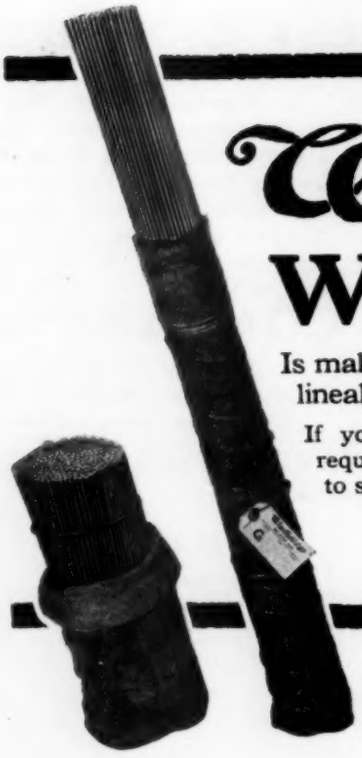

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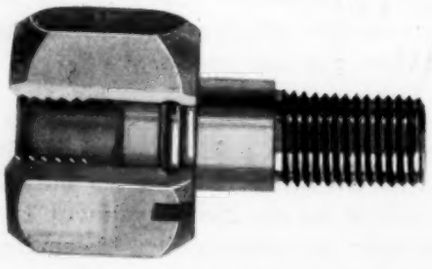

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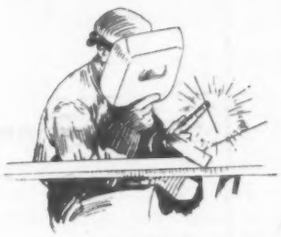

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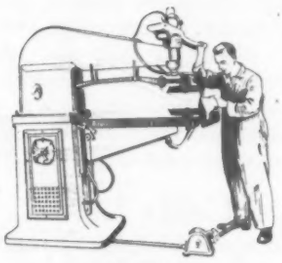

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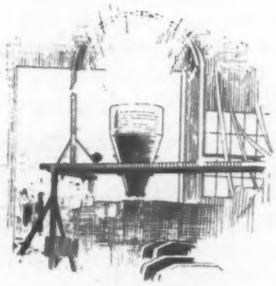

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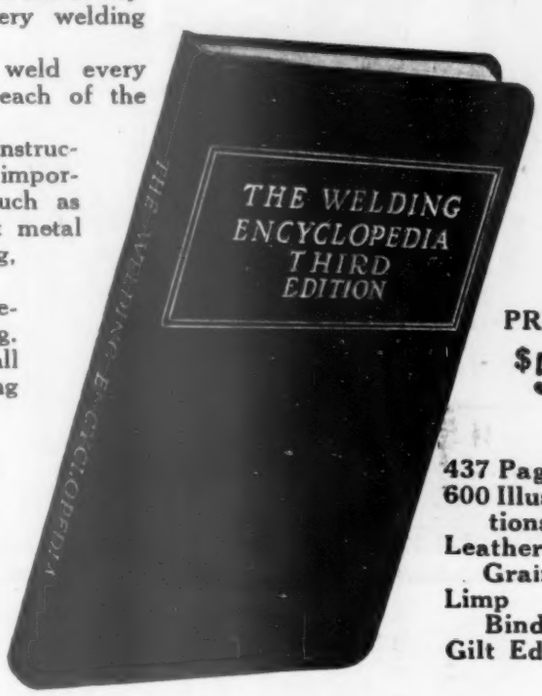

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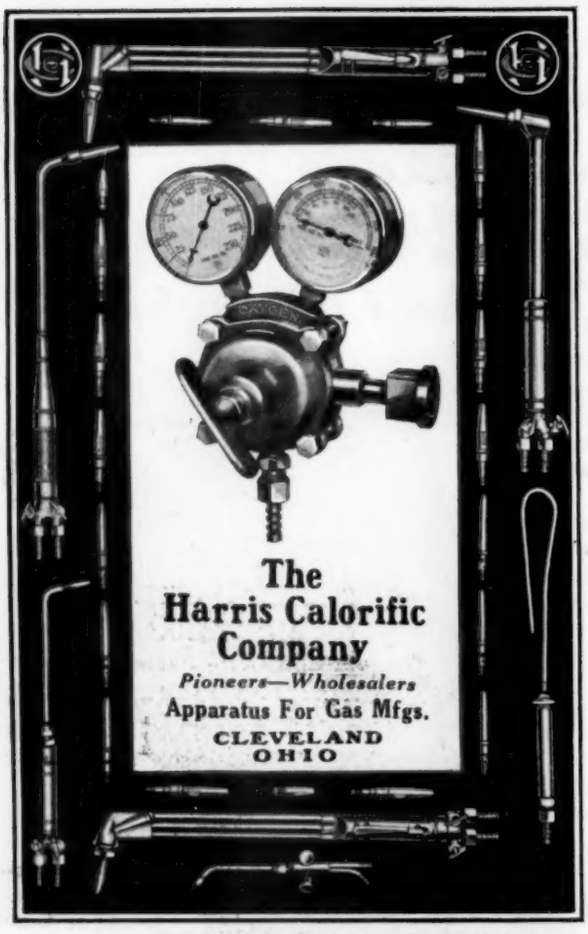

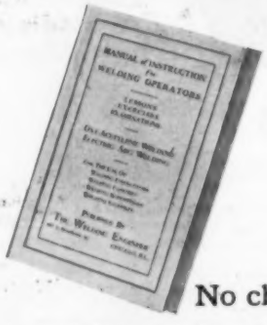

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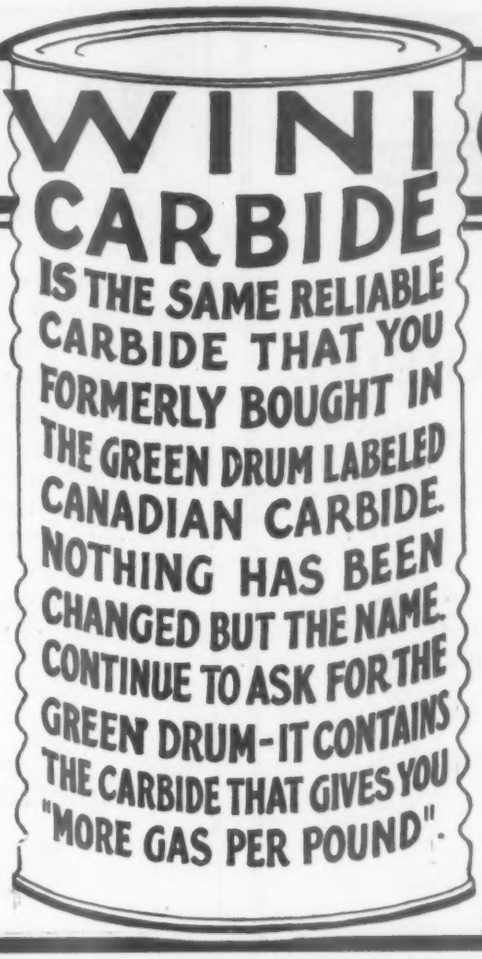
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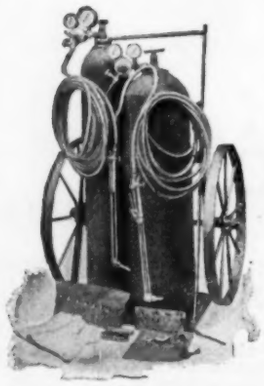

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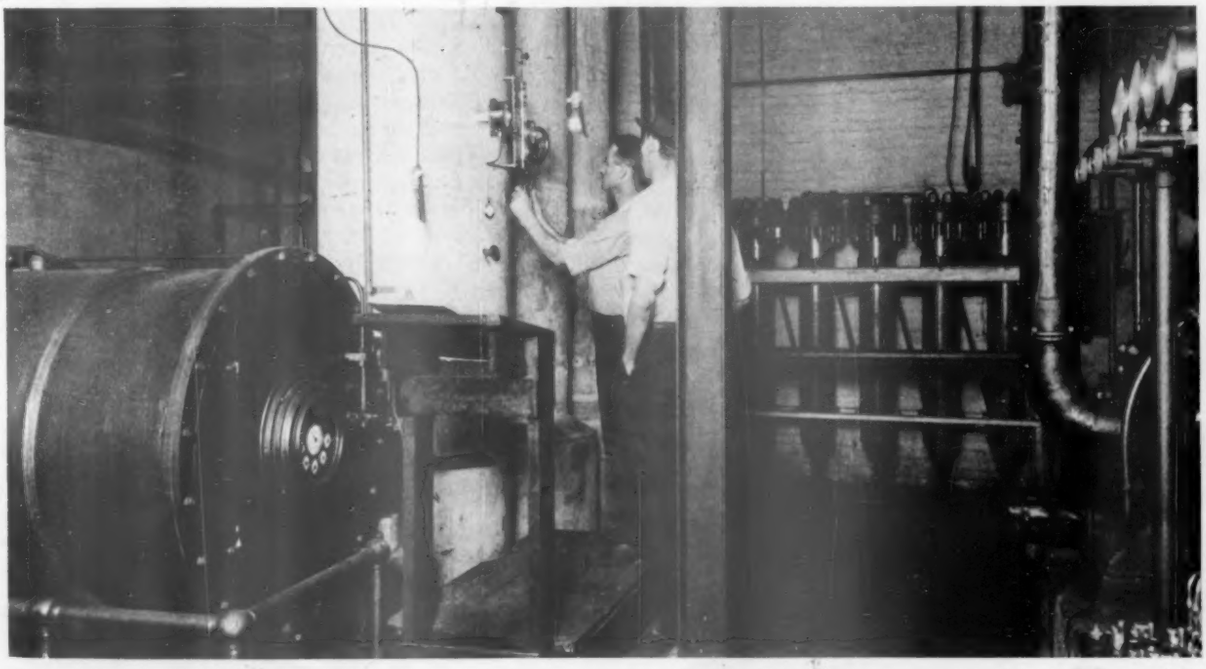

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EIGHTH INTERNATIONAL CONGRESS

Revival of the International Gathering in Paris Witnesses the Discussion of Many Interesting Acetylene and Welding Problems

Thursday, December 13th: Opening Congress

The session was opened at 10 o'clock A. M. by Mr. Fouche, President of the Organizing Committee, who extended a welcome to the Foreign Delegates and French Members. He thanked the Representatives of the different Government Departments who graciously consented to act as Patrons for the Congress, and declared the Proceedings to be open.

Mr. Fouche wished to extend special thanks, on behalf of all the Members, to General Sebert and General Inspector Mr. Vieille, both Members of the French Institute, who kindly consented to act as Honorary Presidents of the Congress.

Mr. Fouche read a letter sent by the International Acetylene Association, as follows:

We take this opportunity to extend most cordial greeting with the most earnest hope that your meeting will be a complete success and with deep regret that it is not our privilege to attend in person.

In America, we watch with the greatest interest and appreciation the technical advances in the use of acetylene which have been so constantly and splendidly developed by the Chambre Syndicale de l' Acétylène et de la Soudure Autogène and the other Associations and acetylenenists of Europe. We feel deeply indebted to our European brothers for the suggestions and practical applications of acetylene, which we have taken up and utilized in this country.

Permit us on behalf of the acteylenists in the United States to extend to you our most cordial expression of admiration and respect.

The program included the appointment of the Officers. Mr. Pinchon proposed Mr. Fouche for reelection as President, and in a few eloquent words recalled the first research work of the latter and his invention of the first oxy-acetylene torches. Mr. Fouche was unanimously elected President of the Congress.

The President proposed for reelection the Officers who had hitherto acted. The vote was carried unanimously.

The President asked the Congress to appoint as Foreign Vice-Presidents one Member for each Country represented. He suggested the appointment of: Mr. Liversidge (England) Mr. Champy (Belgium), Mr. Rodrigo De Rodrigo (Spain), Mr. Gorter (Holland), Mr. Tofani (Italy), Mr. Gandillon (Switzerland).

Mr. Tofani (Italy), in a few eloquent words, extended thanks on behalf of the Foreign Vice-Presidents and all Foreign Members. He recalled the Rome Congress of 1913, of which he was President.

The President then had the list of Papers submitted to the Congress read over. He then asked Mr. Sevin, Engineer of the Arts and Manufacturers, to read his paper on "The Carbide Works in France."

In this paper, after enumerating all the Companies which own carbide factories either for lighting and welding purposes or for the manufacturing of cyanimide, Mr. Sevin deals in detail with the features of each factory. He ends by a brief account of carbide production and consumption in France.

Mr. Pierre Rosemberg then read the "Standards for the Calcium Carbide Trade" which have recently been drawn up by the Chambre Syndicale de l'Acétylène et de la Soudure Autogène to come into force from January 1st 1924.

The French Standards for calcium carbide, after recalling the old classification of carbide according to size, which is retained and includes: lump carbide, which is the usual variety, broken carbide, in 4 sizes: 15 to 20 millimeters, 20 to 40mm., 40 to 60 mm., 60 to 80 mm., and granulated carbide: 1 to 2mm., 2 to 4 mm., 4 to 7 mm., 7 to 10 mm., 10 to 15 mm., settle the question of refuse and useless dust, which should not exceed 5% of the weight of the carbide purchased. They also define the gaseous yield, i. e. the number of litres of acetylene produced by 1 kilog of carbide at 15° C. and under 760 mm. atmopsheric pressure.

The Standards state that lump and broken carbide should have a normal gaseous yield of 280 litres of acetylene per kilog, with an allowance of 3% within the limits of which no reduction in price may be applicable. For 15/20 mm. broken carbide, this allowance is raised to 10%.

Below the above figures, and down to 250 litres per kg., the buyer shall be entitled to a rebate in price in proportion with the insufficiency of yield. Below 250 litres, the goods may be refused by the purchaser.

Granulated carbide is not subject to any guarantee as to yield

The Standards also regulate the question of gas purity, as well as the taking of samples and analysis and a few secondary points. The taking of samples and the analysis shall be carried out in accordance with the instructions drawn up by the Office Central de l'Acétylène et de la Soudure Autogène.

The President then opened the discussion. Mr. Bottini (Italy) asked that these Standards be submitted with a view to their being adopted by all countries and become International Standards for Calcium Carbide.

Mr. Gandillon (Switzerland), while in agreement with Mr. Bottini's proposal, thought it indispensable to appoint an International Commission which would study the Standards now in existence in several countries and make proposals in the matter.

Mr. Tofani (Italy) and several other Members expressed their views in this important matter, and finally a Commission was appointed to draw up International Standards for the Calmium Carbide trade.

Thursday, December 13th: Afternoon

The session was opened at 3 o'clock under the Chairmanship of Mr. Fouche, President of the Congress, who invited the Foreign Vice-Presidents to sit near the Officers at his side. The President then invited the General Secretary to read a note on behalf of the Chambre Syndicale de l'Acétylène et de la Soudure Autogène, entitled: *Draft of General Prescriptions Regarding Autogenous Welding and Cutting Installations.* Printed copies of this draft were distributed among the Members. The General Secretary stated that it is now being considered by the French Ministry of Labour.

After preliminary considerations, this draft was divided in 8 Chapters:

Calcium Carbide: general prescriptions, packing, storage, opening and emptying carbide drums, use of carbide. Acetylene Generators: general prescriptions, fixed and portable types. Purifiers, Piping. Dissolved Acetylene, Oxygen, Hydrogen Etc. Welding and Cutting Stations: hydraulic valve, reducing valves, rubber tubing, torches. Starting, Working, Stopping of Plants. General Precautions, Upkeep. Health Measures, Accidents.

A paper was then read on behalf of the Chambre Syndicale de l'Acétylène et de la Soudure Autogène, entitled: *Provisions for the Construction by Means of Autogenous Welding of Steel Vessels for Compressed, Liquefied and Dissolved Gases.* Copies of this paper were distributed among the Members. It is a Specification for the supply of steel vessels made by autogenous welding and intended to contain compressed, liquefied or dissolved gases.

This paper embodies 13 chapters dealing with: General provisions, purposes of the specification, wording of orders and contracts; quality of metals; supervision and reception tests; choosing vessels for testing and test samples; materials to be used for welding; torches used; workmanship; preparation of sheets and execution of work; improving welded portions; reception tests; testing of samples; Official tests by the Administration des Mines.

A third paper by the Chambre Syndicale de l'Acetylene et de la Soudure Autogène was then read regarding *Draft Regulations Regarding Metal Vessels for Containing and Carrying Compressed, Liquefied or Dissolved Gases.*

This draft contains an introduction and draft regulations now being considered by the Ministry of Public Works and the Ministry of Labour.

These sundry papers were submitted to the Officers of the Congress for the guidance of those countries which possess as yet no provision or regulations regarding such constructions or matters, or which would wish to alter existing regulations.

The President then asked Mr. A. Zivy, Consulting Engineer, to read his paper which, in a clear and interesting manner, deals with *The Proposed Reform of the French and International Patent Law.*

This paper contains an account of the revision of the International Convention now being undertaken under the leadership of the Commission for Intellectual Cooperation of the League of Nations. It ends by stating that the idea to be retained is that the Patent Law is now in a process of evolution. This evolution is a fact, as Commissions are busy drafting new Conventions.

The reform of the French Patent Law, while being under consideration in the competent circles, has not as yet attracted in Parliament the attention it deserves.

Mr. C. Simon then read his paper entitled: *On the Use of Acetylene as a Source of Motive Power.*

After a few general remarks, Mr. Simon examines the special features of acetylene as a fuel for internal combustion engines, the drawbacks which may be attached to its use, then the means and cost, and concludes as follows:

There is no reason why the use of acetylene as a motive agent should not become general as, under the present circumstances, the cost of the energy obtained is not prohibitive.

Owing to its easiness of production, acetylene makes it possible to have an engine which would be easy to start and to run.

Acetylene can also be used for starting motorcar and semi-Diesel or Diesel engines by introducing a certain volume of this gas into the cylinders according to the power to be obtained.

It therefore appears that no effort should be spared in order to design a perfectly adapted acetylene engine, either of the alternative motion or of the turbine type; by this means the wishes frequently expressed by several scientific bodies regarding the production of a national fuel may be satisfied.

The President opened the discussion. Several Members congratulated the author for the work as submitted. No objection was made as to the technical side of this paper.

Professor C. F. Keel was then asked to read his paper on *The Safety of Acetylene Generators.*

In this paper, Mr. Keel describes the different types of generators and their working. He relates the explosions which have occurred in Switzerland and examines the causes of the same.

His observations lead him to the following conclusions: the carbide to water system has caused more accidents than the water to carbide system.

Explosions have occurred more frequently where smaller sizes of carbide were in use.

Mr. Keel then examines how, in his opinion, the soundest generator design should be understood. He recommends the use of lump carbide and especially the separation of generator and gas bell.

Friday, December 14th: Morning

The forenoon of Friday, December 14th, was entirely devoted to visiting the Exhibition of the Physical Society, and especially the exhibits of the Electro-Chemistry, Electro-Metallurgy, Calcium Carbide, Oxygen and allied groups.

The meeting place for the Members of the Congress was the exhibit of the Office Central de l'Acétylène et de la Soudure Autogène, where demonstrations were made of welding, heavy cutting and under-water cutting; the Members also witnessed molten carbide being poured out of an electric furnace. They then listened to a brilliant lecture by Mr. Georges Claude on liquid air, illustrated by numerous experiments, at the Air Liquide exhibit, and went round the exhibits of La Soudure Autogène Francaise, Compagnie Universelle d'Acétylène et d'Electrométallurgie, Compagnie Générale d'Acétylène, Société d'Electrochimie, Société Industrielle des Produits Electrochimiques de Bozel Lamotte Comptoir Francais de Carbure de Calcium, as well as the joint exhibit of 400 square meters.

Friday, December 14th: Afternoon

The President asked Cauchois, Managing Engineer of the Association Normande de Propriétaires d'Appareils à Vapeur, to read his paper on: *Considerations on the Use of Gas and Electric Arc Welding for Boiler Repairs.*

Mr. Cauchois first examines the working conditions of a steam boiler, then the strength of welded joints, the defects in welds, the guarantees offered by welders as to ability, and finally gives his conclusions. As an annex, he distributes among the Members of the Congress the Recommendations as to steam boiler repairs by gas and electric arc welding adopted by all French Steam Apparatus Owners Associations.

The general provisions contained in this document are the following:

1. No repair by means of welding can be permitted or undertaken which, if faulty in any respect, might entail damage which might result in an accident.
2. In principle, no joint should be made by gas or arc welding, which has to bear normally traction or bending strains.
3. It is desirable that no repair by welding should be carried out on a boiler or similar apparatus before the Association responsible for its supervision has been notified.

The above is followed by data as to reinforcements, cracks, etc., the selection of apparatus and welders, the execution of welds, and the testing operations.

When the discussion was opened by the President, Professor Keel asked leave to submit a few objections, especially as regards guarantees concerning the proper carrying out of the welding work. He pointed out that while the said Associations are sometimes justified in showing much reserve in connection with repairs, the same should not apply to duly qualified workshops, and that the construction of steam boiler parts offers, in the same workshops, all desirable guarantees.

The President then asked Mr. Pierre Rosemberg to read his paper on *Recruiting, Educating and Improving Welders in France.*

In this short paper the author, after reviewing the way in which welding operators have been recruited and educated in the early stages of autogenous welding, and after a few words concerning the quality of welding workmanship during the War, shows the efforts which have been, and are still made every day, in order to imporve the welders.

The President then asked Mr. Guyot, Scientific Engineer of the Société Alai, Froges et Camargue, to read his paper on *The Uses of Acetylene in the Chemical Industry.*

The author first reviews the historical facts relating to acetylene and the first researches of scientists such as Davy and Berthelot, and then shows how acetylene, being the starting point for all organic syntheses, was for a considerable time considered as a laboratory product, the preparation of which was difficult and unpractical.

After this introduction, the author explains the stages of manufacture of acetylene derivates with chlorine: tetrachlore-

thane, trichlorethylene, monochloracetic acid, and indicates their applications. He then deals with the production of acetaldehyde, leading to paraldehyde and metaldehyde, alcohol, acetic acid, etc.

Finally, the author draws the attention to the capital importance of the cost price of acetylene, on the future of these new manufactures, and, by means of a practical example, shows the consequences which would follow the development of an improved electric furnace in lowering the cost price of raw material.

The members then listened to the reading of a paper by Mr. J. Rosemberg of the Société Française de l'Acétylène on *The Use of Oxy-Acetylene Lighting for Cinematograph Purposes.*

In this paper, the author describes a complete cinematograph plant in which the lighting is obtained through an oxy-acetylene blowpipe flame impinging on a pastille of rare earth. This blowpipe affords the same lighting power as an electric arc of 20 amperes. Sufficient lighting power can also be obtained through a simple air-acetylene bunsen burner for projecting on a small screen at a distance of 8 meters. The latter system is specially designed for use in schools.

The President then pointed out an oxy-acetylene plant that will be used presently for displaying a few documentary films illustrating the calcium carbide, acetylene and welding industries.

Mr. Granjon then spoke briefly on *The Use of the Cinematograph for Doing Propaganda Lecturing Work in Favour of the Carbide, Oxygen, Acetylene and Welding Industries.*

He explained how interesting it would be so get up either a comprehensive film dealing with all these industries, or a series of separate films illustrating each of them.

Films on carbide, acetylene generators and oxy-acetylene welding were then exhibited on the screen.

Mr. Granjon then read, with a few comments, two notes by Mr. Le Grix, viz.: *A Reacting Agent for the Study of the Oxy-Acetylene Flame,* and *How Cast Iron Breaks.*

Saturday, December 15th: Morning

The proceedings began with a reading of the *International Enquiry Regarding the Carbide, Oxygen, Acetylene and Welding Industries.*

In the introduction, the General Secretaries, who have compiled and summarized the information sent by the different countries, draw the attention to the interest of this enquiry, extend their thanks to the correspondents who supplied the particulars, and explain that a certain number of countries, including Japan, Canada, South America, the United States, Australia could not send their reports in time, and that the enquiry continues, the complete results to be ready when the full account of the Congress is published.

The results of the enquiry were then read concerning: Belgium, which consumes about 5,000 tons carbide and 1,500,000 cubic meters of oxygen; Denmark, which consumes 2,000 tons carbide and 5 to 600,000 cubic meters of oxygen; Spain, which produces 20,000 tons carbide in 13 factories, consumes 18,000 tons, possesses 16 oxygen factories and consumes 2,000,000 cubic meters; France, which possesses 25 carbide factories producing mainly for home consumption, which amounts to about 60,000 tons, 30 oxygen factories, and consumes 15,000,000 cubic meters of this gas.

Great Britain, which consumes 28 to 30,000 tons carbide, and possesses 20 oxygen factories with a consumption of 12,000,000 cubic meters; Holland, which consumes 5 to 6,000 tons carbide and 1,500,000 cubic meters of oxygen produced in 8 factories; Italy, which possesses 11 carbide factories producing 25,000 tons of carbide consumes 18 to 20,000 tons, 30 to 35 oxygen factories with a consumption of 4,000,000 cubic meters; Poland, which consumes 12 to 15,000 tons carbide and possesses 8 oxygen factories, consumption unknown; Roumania, which has one carbide factory and 4 oxygen factories, the consumption of this gas being 6 to 700,000 cubic meters; Sweden, with carbide factories having a large production for export purposes, as Sweden only consumes 3,000 tons, 15 oxygen factories producing for home use 500,000 cubic meters; and Switzerland, with 15 carbide factories, 8 of which are running, the consumption being 3,000 tons carbide and 900,000 cubic meters of oxygen produced in 13 factories.

Mr. Ed. Hays then read a paper on the *"Designation of Acetylene Generators."*

He asks that every generator bear a plate indicating the maximum carbide capacity, the maximum production per hour in litres and several other indispensable data.

The President then asked Mr. C. Simon to read his paper on *The Use of Dissolved Acetylene for Railway Signals.*

Mr. Simon relates in a few words how Mr. Gustav Dalen, in Sweden, worked out the lighting problem for lighthouses and buoys and especially of railway signals, by means of intermittent flashing systems.

The standard adaptation of the flash system, in the case of a railway signal, consists of: the gas tank or dissolved acetylene cylinder, the pressure reducing or regulator valve, the pressure gauge, the whole being placed in a sheet iron case at the foot of the signal mast in a convenient position.

The low pressure piping starts from the regulator, runs along the mast and reaches the flash arrangement proper. The flash arrangement is of special design—railway type—and includes a burner, a pilot light and a rythm regulating lever. The lantern may be of any type with a suitable optic.

Mr. Simon describes these organs in detail, and states that at the present time there are, in Sweden, 3,900 installations in use on the large railway systems, 1,800 in the United States, 300 in Denmark, 250 in Russia, 200 in Finland, 180 in Austria. In France, the matter has been under consideration for a few years, and the Compagnie Générale d'Acétylène, who owns the Dalen Patent Rights in France, has installed a certain number of plants on various large railway systems.

Professor Keel then read his paper on *The Combustion of Reducing Valves.*

The Société Suisse de l'Acétylène, officially entrusted with the control of safety measures against accidents in acetylene and welding plants, has had to investigate the cases of explosions due to reducing valves and oxygen cylinders.

Professor Keel, who was responsible for such investigations, has noticed that certain makes of reducing valves exploded fairly often, while the fact occurred very seldom with other makes. He was led to make a closer study of the causes of these ignition phenomena.

valves, and also the use of soapy water to check the tightness.

As a first cause, he notes the lubrication of the reducing

As second causes, there are the heat due to compression in the reducing valve connection when the oxygen valve is opened roughly. As other causes, one may imagine that foreign bodies, for instance rust, burst out from the oxygen cylinder and act as catalysing agent.

In the last place, there is another cause of ignition, in which many, including several authorities, refuse to believe, but which appears to be evident, as it explains certain explosions which were certainly not due to the above causes.

This cause resides in static electricity, says Mr. Keel, who examines this question in detail. He concludes by advocating the thorough drying of oxygen and asks every other Association to take up and study this problem and report on the results or suggest experiments.

Saturday, December 15th: Afternoon

There was first a paper by Mr. R. Granjon on *Acetylene for Private and Industrial Lighting.*

Mr. Granjon explains the conditions of lighting before the War and shows how and why a great number of fixed installations have disappeared.

He also gives the reasons why the revival of lighting was not promoted as it should have been, and states that, if acetylene light-

ing is to be pushed again, another formula must be found for inducing people to buy installations and perhaps also for designing such installations.

He mentions the work now undertaken by the Lighting Committee of the French Chambre Syndicale, and wonders whether there would not be possibilities for private lighting by means of dissolved acetylene. In his opinion, the last word has not been said and the cost of acetylene lighting compares as favourably as before the war with that of other means of illumination.

The President then asked Mr. Piette, of the Office Central de l'Acétylène et de la Soudure Autogène, to read his paper entitled *Contribution to the Study of Steel Cutting by Means of the Oxy-Acetylene Torch with the Jet of Oxygen.*

In this paper, the technical and practical methods are defined which lead to the quickest and most economical cutting of steel of all thicknesses. The paper consists essentially in describing all the tests carried out, which are summarised in a series of diagrams, the particulars of which are described fully, and without which it is difficult to explain in a few words the carrying out of the tests and the results obtained.

Mr. Ch. Picard was then asked to read his paper on his new *Under Water Cutting Torch.*

After recalling a few historical facts about the use of the cutting torch under water and describing the various apparatus constructed, Mr. Picard shows the features of his new torch, the chief advantage of which is to do away with compressed air for keeping the water aside, the more or less efficient re-lighting arrangements for igniting the flame under water being replaced by a very simple device which fulfills the same purpose.

Mr. Pierre Rosemberg is then asked to read a summary of the three papers sent from America and dealing with interesting welding achievements:

1. *The Development in Pipe Line Welding,* by N. E. Wagner, Prairie Pipe Line Co.

This paper shows how 107 miles of 8 inch pipe and 34 miles of 6 inch pipe were laid by means of autogenous welding for oil carrying purposes. The paper gives also a summary of the advantages of autogenous welding for this kind of work.

2. *Largest Oxy-Acetylene Welded Equipment Ever Built,* by Raymond R. Orwig, The Reeves Brothers Co.

This paper deals with the construction, by means of autogenous welding, of 3 rotary lime kilns, each measuring 125 feet in length with their coolers of 5 ft. by 50 ft. These kilns consist of shells having a diameter of 8 ft. welded end to end, two rings of 30 ft. section being interposed at the centre.

3. *Large Gas Holder Fabricated by Oxy-Acetylene Welding,* by C. P. Carter, Consulting Engineer, Linde Air Products Co.

This paper deals with the construction of a gas holder holding 50,000 cu. ft., consisting of a tank and a gas bell, and entirely made by autogenous welding.

Mr. Chaplet asked leave to read a short paper summarising a few historical facts relating to the manufacture of calcium carbide. This was answered to by Mr. Gall, who rectified some of the statements made. Mr. Chaplet replied in his turn, and this short discussion was declared closed by the President after Mr. Tofani had remarked that such details as those under discussion did not matter, when it was an established fact that the invention of calcium carbide was mainly the result of the work of French scientists and inventors.

Mr. Gall then read a paper on *Cyanamide and its Derivates.*

After a short historical review, he gave every information regarding this industry in France, on the important services it renders to agriculture, on the founding of large factories and the future development of cyanamide and its derivates.

CLOSING SESSION OF THE CONGRESS

The closing session of the Eighth International Congress was opened at 5 o'clock. The President, Mr. Fouche, extended a welcome to General Sebert, Member of the French Institute, Honorary President, who took place in the Chair.

The President recalled in a few words how General Sebert, who presided on the Third Congress in 1900, never ceased, since that time, to take an interest in our industries, the progress of which he constantly followed. He thanks General Sebert for his kindness and courtesy in attending the closing sitting.

General Sebert thanked Mr. Fouche for his wishes, and said he regretted that, owing to his health, he was not able to collaborate as actively as formerly to the work of the Chambre Syndicale. He recalled the interest which the great scientist Marcelin Berthelot showed towards acetylene, and addd that the development of autogenous welding in France was for a great part due to the organization of the Office Central de l'Acetylene et de la Soudure Autogène.

The President read a letter from the Minister of Commerce, apologizing for not being able to attend to the closing session, as he had been obliged to start for the provinces the same day.

The President came back to the question discussed at the first sitting after the reading of the "Standards for Calcium Carbide," and advocated the appointment of a Permanent International Committee, who would be entrusted to deal with all questions left in suspense following upon the 9th Congress.

Mr. Liversidge asked that the Congress should decide that the 9th International Acetylene Congress should take place in London in 1924. A discussion followed, and some members pointed out that the date of 1924 was very close at hand for holding a Congress, and that by that time all questions submitted to the Permanent International Committee for study would not be settled.

The President asked the Members for their opinion as to the period which should separate this and the next Congress, and suggested that the next Congress should take place in 1926, i. e. in three years time. The president asked a vote on this proposal, which was adopted unanimously.

Mr. Bottini asked that the Permanent International Committee should be left to decide, subject to the approval of the different countries, on the country in which the 9th Congress will be held.

Mr. Gandillon and Mr. Tofani suggested that, in order to satisfy Mr. Liversidge, and with a view to the fact that an important exhibition is to take place in September, 1924, it should be decided that the Permanent International Committee should meet in London at that time and settle the question.

Consulted by the President on this question, the Congress unanimously adopted this proposal. It is therefore understood that the Permanent International Committee will meet in London and that it will have the power, after hearing the interested parties, to decide on the country and place where the 9th International Congress will be held in 1926.

The President then proposed that the Members of the Permanent International Committee should be appointed at the rate, for the moment, of one member for each country represented, these members having to admit one delegate for each country invited to the present Congress but not actually represented. After a few minutes suspension to allow the foreign members to consult each other, the President read the list of the Members proposed:

Great Britain:	Mr. Liversidge
Belgium:	Mr. Caris
Spain:	Mr. Rodriguo De Rodriguo
United States:	Mr. A. Cressey Morrison
France:	Mr. Fouche
Holland:	Mr. Gorter
Italy:	Mr. Tofani
Switzerland:	Mr. Gandillon

After a discussion, it was decided that the Permanent International Commission would, in each country, call for members whose competency would be found necessary for studying the questions under consideration.

Mr. Tofani suggested that the Permanent International Committee should have its Headquarters in Paris, and that Messrs. Granjon and P. Rosemberg should be appointed secretaries, which proposal is adopted unanimously.

(Continued on Page 24)

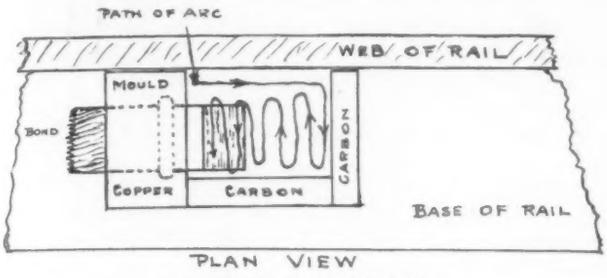
ARC WELDING COPPER TO STEEL*

Research in the Matter of Welding Rail Bonds Develops New Process for Making Strong Welds Between Two Dissimilar Metals

By Chester F. Gailor†

MY remarks will be confined principally to the practical application of the copper to steel process of arc welding, developed by the Rail Welding & Bonding Co. This process of welding is the result of about two years intensive research work, found necessary during the deveopment of their business of rail bonding for electrical purposes.

The fact that satisfactory copper to steel welds can be readily made for bonding purposes, under the great variety of conditions



Use of Blocks to Make Mold

existing on the railways in this country, indicates the possibilities that may be expected from the use of this process of welding in the industrial welding field.

The development of this process of copper to steel welding, being comparatively recent, has precluded our paying much attention to the commercial application of this process. In fact, the Rail Welding & Bonding Co. confine their activities principally to the Electric Railway industry. However, I hope to be able to explain the characteristics of this process of welding enough to enable you to successfully employ this method of welding on all welding jobs where copper to steel or copper to copper welding would be desirable.

This process of arc welding has several important features which distinguish it from all other methods of welding, and being of such a comparatively simple nature, uniform and satisfactory results are easily obtained. The simplicity of this method of welding can only be realized after you have made a few welds. The skill so necessary in other forms of arc welding is not necessary in this process of welding.

It was found that ordinary commercial copper, when used for arc welding purposes, would not produce a satisfactory weld, and after an exhaustive study of the metalurgical, chemical and physical features involved, a copper alloy rod was developed, which greatly simplified the problem. This copper alloy rod contains a powerful deoxidizer for both copper and steel, which produces a solid close-grained structure exceptionally free from blow holes, slag inclusions or other imperfections commonly found in welds of this nature. The second important feature is the fact that the deoxidizer thoroughly cleanses the surface of the steel, with which it comes in contact, and purifies the copper weld metal, which assures a real weld between the two metals when in a chemically clean and pure state. This is an exceptionally important factor, especially in all bonding work, as it results in such a homogeneous union between the two metals that there are very few instruments capable of measuring the electrical resistance.

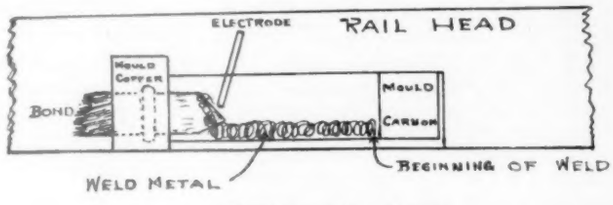
It is well known that the fusing points of copper and steel differ so greatly that heat sufficient to weld steel successfully would produce an inferior structure in the weld metal. However, there are often found small portions of the steel which have been fused and mingled in the welded mass close to the point of contact.

Another feature which is equally important, is the fact that a satisfactory weld can be made without penetrating the surface of the steel. In fact, it is most desirable to avoid all penetration so necessary in other forms of arc welding. The notch effect caused by arc penetration should always be avoided for reasons obvious to all welders.

Copper, as you would naturally expect, flows and welds faster than steel, and is somewhat harder to control. It requires considerably more current to successfully weld with a $\frac{3}{16}$-inch diameter copper alloy rod, than it does with a steel rod of the same diameter.

In order to produce the necessary cleansing action, which results in the best welds of this character, it is necessary to surround the weld with a mould which will confine the weld metal to the exact area to be welded.

The carbon moulds meet the requirements much better than any other material, or combination of materials, known at this time. Carbon as a refractory, will withstand the action of the arc and erosive action of the metal when boiling in the mould, and will not chill the metal as rapidly as most other materials. It was also found difficult to produce a satisfactory weld in the remote corners of the mould, especially on the smaller sizes where the metal and the angle of contact were limited. Here again the carbon proves its superiority over the other materials. In some cases where other materials were used for experimental purposes, it was found very difficult to force the copper metal into the corners of the mould, as the material had sufficient chilling and repulsive action to hold the copper back for an appreciable distance from the corners. This information, however, was decidedly



Method of Welding Webber Bond

useful, because it proved conclusively that acute angles in the mould, and thin and limited sections of copper welding, should be avoided.

The mould is usually made of carbon or a combination of copper and carbon. The carbon is used to line or face the mould. The copper dissipates the heat and allows the mould to be used quite continuously. It also strengthens the mould and prevents disintegration, especially in cases where the carbon cracks quickly. In all cases where a mould of uniform size and shape can be used it is usually enclosed in a steel or iron form, which adds greatly to the life of the moulds and the ease in handling same. In starting the welding operation the arc is always drawn on the carbon to prevent sticking and to avoid penetration or burning the steel.

It is necessary to have sufficient depth of copper metal in the finished weld to allow the metal full opportunity of functioning

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*Paper read before American Welding Society, New York, December 1, 1923.

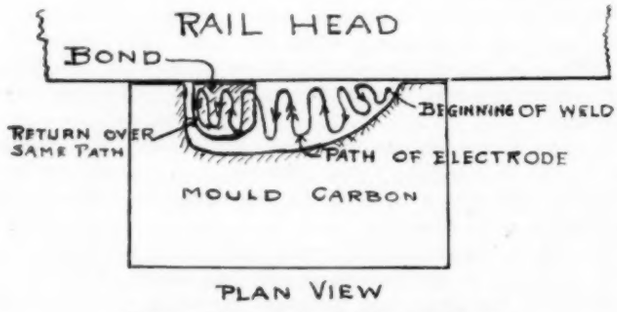
†Consulting Engineer, New York.

as previously described. It will be found that metal ¼ inch or more in depth will produce the best results.

It is important that you do not undertake to weld a larger surface than is possible to cover with and maintain a moulten mass of copper. The metal should be kept in a fluid state at all times during the process of welding.

The investigation and research work covering the development of bond welding, resulted in the development and perfection of two different methods of welding, in which practically the same results were secured. These welding methods are commonly called the carbon arc and metallic process of welding, but in this case certain modifications are necessary to allow for the difference in the principles involved.

The carbon arc process of welding, which includes the use of reversed polarity, that is the carbon electrode is negative, represents closely the usual method of welding with the carbon arc. The best welds are produced where the arc is drawn along the surface of the rail steel close enough to secure the desired weld,



Path of Electrode in Welding Rail Bond

but still far enough away to avoid any direct penetration. The copper alloy metal is added at a speed, and to the extent consistent with the conditions present during the welding operations. The ordinary welder will easily determine the speed of the operations, as well as the amount of metal necessary to produce good results. However, as stated before, copper melts so much faster than steel that the actual welding operation is comparatively short. Most of our copper to steel welds are made in one and a half minutes or less. The welding operation, when this particular method is employed, consumes practically the same amount of time and otherwise compares closely with our metallic method of welding. It appears from practice that this particular method is not only desirable but recommended in all cases where dynamotors, and similar low voltage generating units, supply the necessary electric current.

The second method of welding, and which in reality is the direct result of the exhaustive investigation and research work started about three years ago, resembles somewhat the ordinary metallic method of welding, but is distinctly different, as the welding metal must always be kept in a moulten state, and the length of arc changed from time to time to produce a good weld. In practice the same moulds and accessories are employed. The current is usually supplied by a welder having sufficient capacity and regulation to meet the requirements. The usual practice being to use a ⅛ inch diameter copper alloy rod as a positive electrode, which requires approximately 225 amperes to weld successfully, and keep the metal in the mould hot enough to produce the proper cleansing action.

The metallic method of welding is quite a simple procedure, as you will observe, from the following description: The arc is drawn on the carbon mould and then transferred to the steel surface on which the weld is to be made. In the beginning a comparatively short arc is used to force the copper to cover and weld the steel surfaces in the manner desired; the arc is usually moved back and forth or in a rotary motion, until the surface of the steel is well covered, when the arc is lengthened considerably, as it is then used principally as an agent to melt the remainder of the copper metal being inserted and to keep the metal fluid in the mould.

When welding on or near vertical surfaces it is very interesting to note the apparent capillary action resulting in the copper being drawn above the surface of the weld metal. The steel seems to be a real affinity for the moulten copper, so much so that the copper often extends as much as ⅜ inch upwardly on the vertical surface of the steel.

The strength of copper welds made in this way approximate that of copper castings of the best quality. A careful examination of the samples will show the quality and the structure of the metal. The way it tears when subjected to tension or shearing stresses is also indicative of the real nature of the metal.

The welding of cast iron is a subject which always keenly interests arc welders, and I believe the success usually obtained from welding cast iron depends very largely, if not entirely, on the dexterity of the welder. I will make no promise as to the success to be obtained through the use of this method of welding. When you consider the fact that a reliable weld can be made with a very substantial reduction of the heat element, so unavoidable in other forms of welding, and the additional fact that penetration or disturbing any portion of the metal is avoided, it would appear to be a decided improvement in the elimination or reduction of dangerous factors always present in welding cast iron.

The copper alloy rod referred to contains only a small percentage of other metal, so that the rod is practically pure copper. The exact amount and combination of other metals are the factors which produce the results.

No grinding or special cleaning operations are necessary to assure reliable welds. The ordinary rust, or oxide, on the steel surfaces do not obstruct the welding process. The deoxidizer in the rod takes care of this condition nicely. Paint, grease or similar foreign substances should be removed as a natural precaution taken in all welding operations.

In closing I wish to make a few brief statements which will bring to your mind the essential features of this process of welding:

a. The weld metal must be kept in a moulten state during the entire welding operation.
b. Sufficient alloy rod must be used to allow the elements to produce the necessary cleansing action.
c. The surface of the steel must be carefully covered with moulten copper.
d. The entire operation should be done quickly, so that the steel will be heated only locally and thus retain its physical properties.
e. The arc should be drawn close to the steel, but always far enough away to avoid penetration or burning.

INTERNATIONAL ACETYLENE CONGRESS

(Continued from page 22)

The President then thanked all Members of the Congress for the punctuality and attention they have shown during the Congress, which he trusts will have the most satisfactory consequences for the carbide, oxygen, acetylene and welding industries.

Mr. Gandillon thanked General Sebert and Mr. Fouche, as well as all French Members for the hearty welcome which has been extended to Foreign Members. He spoke about the French organizations, and in particular the Office Central de l' Acétylène et de la Soudure Autogène, "an unique organization" which the whole world envies France. He recalled the establishment of the Office Central and the strong personality of Mr. Ernest Sautter, who presided over it for a number of years. He also mentioned the name of Mr. de Seynes, his collaborator, who led for such an extensive period the Chambre Syndicale de l'Acétylène and afterwards of the Chambre Syndicale de la Soudure Autogène.

Mr. Tofani, in a brilliant improvisation, recalled that France was the birthplace of calcium carbide and acetylene, recalled once more the names of Moissan, Georges Claude, Mr. Gall, and asked all Members, by their applause, to express the thanks which the acetylene world owes to France.

FRENCH WELDING EQUIPMENT

Study of Apparatus Catalogue Shows Marked Differences in the Design and Construction Between American and French Welding Equipment

Paris, France.
Tuesday.

Dear Ed:

I just got back from the opera and seeing that I have not written you for some time thought that there would be no time like the present. There are no two ways about it, Ed, every time I witness anything impressive I cannot help but feel that I should tell you all about it. Take the opera building, for example. It is located in practically the center of Paris, and forms one of the hubs from which the boulevards radiate. This is a form of city planning which is noticeable everywhere. These hubs or centers of activity can be found every so often and from them the streets run out just like spokes in a wheel. When a fellow enters the opera he has the same feeling which comes over him when entering some of our large State Capitol buildings, where the immense size of the interior makes him feel infinitesimal. The space in that receiving room was wonderful to behold. The immense pillars and marble stairs certainly were impressive. Picture, if you will, against this background the brilliant red and gold dress uniforms of the military guards, who pace the corridors and you will have some idea as to the mental attitude of the visitor. So far as the opera itself is concerned, it is a very popular entertainment in Paris; everybody goes. The prices are very reasonable and the performance very good; there is the answer.

But I wanted to tell you, not so much about the opera, as about the welding information I gleaned since my last letter. The Eighth International Acetylene Convention took place last week and was all very interesting, some things of course much more than others. The first meeting was held at the Civil Engineers' Building on the morning of the 13th. In the afternoon the meeting took place at the Office Central. The next morning everybody visited the Exposition at the Grand Palace. This was followed in the afternoon by another meeting at the Office Central. On Saturday, which was the third and last day of the meeting, the morning meeting took place at the Office Central, followed by an afternoon meeting at the Civil Engineers' Building. The grand finale was in the nature of a banquet at l'Hotel Lutetia.

The principal thing that impressed me was the display of French welding equipment which I am sure you will be interested in hearing about and comparing it with that you are using. It is not at all strange that the equipment used in different countries, just like the customs and habits of the various people, should be different. I am sending you a catolgue showing quite a variety of apparatus manufactured by one company which incidentally happens to be the largest in this county. There seems to be a prevailing idea among the French designers that the varying temperature of the oxygen gas is responsible for the variance found in the welding torch flame, after it has been used a minute or two. They maintain that the oxygen expanding, as it does, becomes very cold and does not mix as thoroughly with the acetylene gas, which is at a higher temperature, as it should. Therefore, on many of the torches, or blowpipes as they are commonly called here, it is not an uncommon thing to find great coils of tubing wrapped around the torch and extending up into the heat zone, as close to the tip as possible. This procedure, it is contended, warms up the oxygen and allows both gases to intermingle at somewhere near the same temperatures.

I really haven't detected any great difference in the torches, due to this particular construction. After the tip heats up the same flame adjustment is necessary as with our own. However, this may not be their whole reason. I heard one chap indicate to a friend that the reason the oxygen was warmed up in this fashion was to cause an expansion and increase the pressure, in order to make the operation more efficient. There may be something to this, as it certainly sounds more plausible than the first explanation.

You will see from the illustration that there are a great many shapes and sizes of welding torches. The most popular seem to have the oxygen control in the middle of the handle, so that it is readily accessible to the thumb and forefinger of the operator's torch hand. This feature allows him to influence the flame in whatever manner he desires without removing the torch from the weld, or using the left hand.

This impresses me as being quite a desirable feature on this class of apparatus, for you must remember that ninety per cent or more of all the equipment used in France is of the low pressure type, and that the oxygen valve really controls both gases. There are a few torches on display which have no acetylene valve at all, but the majority employ what we call an ordinary gas cock on the acetylene line simply as a shut-off means. There is no packing used in this gas cock, so I imagine that it would not be practical to use such a torch on pressure acetylene for fear of the acetylene gas leaking at this point. In addition to this it would be practically impossible to obtain a fine acetylene adjustment through the use of such a control, if acetylene gas under pressure were employed.

I feel quite sure that the cutting torches will hold your interest. Their general appearance is so vastly different from what you have been accustomed to, that you will probably study over the illustrations given. Somehow or other, the French operators do not seem to "take" to the quick acting high pressure valve on their cutting torches. The majority of torches simply have a needle valve for this purpose and the French engineers state that their trade will accept no other. Pay particular attention to the cutting torch with the gauge built in the high pressure line. This is to allow the operator to tell exactly how much pressure his oxygen cutting jet is receiving. It appears that on certain classes of work some operators claim that they can produce much better results by the use of such an indicator. Then too, notice the particular construction of the cutting torch for under water cutting. It has, as you will observe, a bell shaped housing around the tip which receives the compressed air, used for displacing the water. Last, but by no means least, when touching on these cutting torches, is the one used for cutting out tubes in boilers. This has a very small head and short nozzle, so that it can be inserted inside the tube and revolved, making a cut at right angles.

When telling you about the cutting torches I almost forgot about the most impressive of all. This was a torch to use ordinary gasoline in connection with oxygen. The gasoline is placed in a container which holds about five gallons at a time. It is then pumped up with an ordinary hand pump until a certain pressure is reached in the tank. It is then passed through a hose to the special cutting torch, which is arranged to gasify it and used as a means of preheating. You will also note the regulators, or as the French say "manodetendeurs." These function on the same principles as most regulators, but they are a little confusing to us Americans at first, simply because the oxygen connections are much along the lines of some of our acetylene tank connections, whereas, the connection for the acetylene tank, as used in France, are much the same as we use on our carbon dioxide cylinders which are supplied by the dental accessory people.

The acetylene generators are much the same class as the other equipment, namely, very much different in style and

Another REGO Scoop

Five years ago the Bastian-Blessing Company announced the development of a torch guaranteed not to flashback. That announcement was the beginning of a new era in torch construction. Since that time we have been complimented by many infringers and near-infringers.

It is our policy to keep the REGO line in its position of **leader** in efficiency and adaptability in the welding industry. In line with this policy we have developed a new series of torches of goose neck construction. We **don't** claim that ours is the first goose neck torch but we **do** claim that ours is the **first goose** neck torch that embodies **all** of the following features:

1. A construction guaranteed against **flashback;**
2. Elimination of the objectionable and sometimes **dangerous** feature of **mixing in the handle;**
3. Elimination of the necessity of constant **change** of mixing chambers.
4. Wide range of tips that are **easily** interchanged;
5. Substantial in **all** of its details.
6. Real honest-to-goodness **nickel copper** heat-resisting tips **(not** copper **coated** brass);
7. Taper drilled tips that develop long perfectly neutral cones.

The Bastian-Blessing Co.
246 E. Ontario St., Chicago, Ill.

REGO
MODEL GL
GOOSENECK
WELDING TORCH

The REGO GL large gooseneck torch is the ideal torch for the big shop with a wide range of work. With its assortment of 3 extensions and 10 tips it will handle any welding from the heaviest preheated job down to light sheet metal work.

For a full discussion of the whys and wherefores of the REGO principle, write for a "Facts" booklet.

We will not discontinue our popular line of two tube angle torches but will manufacture both the new style and the old style.

REGO Gooseneck Welding Torches

REGO GL Torch

A large torch for heavy preheated castings, engine cyinders and frames, large pipe welds, and general heavy repair and production work. Furnished with 3 extensions and 10 tips.

Any assortment of torch extensions and tips may be had if specified.

REGO GL torch only—13 in. long —no extensions or tips..... **$25.00**

6 in. extension only—for tips 1, 2, 3 and 4..... **5.00**

12 in. extension only—for tips 5, 6 and 7..... **7.50**

24 in. extension only—for tips 8, 9 and 10..... **10.00**

REGO GL tips, each..... **1.75**

REGO GL torch, complete with 3 extensions and 10 tips..... **65.00**

REGO GM Torch

A medium torch for work up to 1 in. on iron, steel, copper, bronze and aluminum. Just the torch for pipe welding, automotive repair and production, tank and other medium welding.

Length, 20 in., Weight 25 oz.

Price—GM torch, 6 tips and 6 in. extension **$27.50**

Extra extension, 12 in. long for.... **7.50**

REGO GS Torch

A small handy torch especially popular for light production work, such as the welding of milk cans, small tanks, kitchen utensils, fenders, electrical parts and all metal construction limited to 5/16 in.

Length 14 in., Weight 15 oz.

Price—GS torch with 5 tips..... **$20.00**

The Bastian-Blessing Co.
246 E. Ontario St., Chicago, Ill.

design to that which we are accustomed to. All of the generators are of the low pressure type. Some are of the automatic type, while others must be operated by hand. A great many have gas holders, either built in the generator itself, or as a separate equipment. All of the generators can be divided into two types, the first being a "water to carbide type," and the second "carbide to water." There seems to be a marked preference for the "water to carbide."

I was very fortunate in being able to pick up a cross-section diagram of one of the "carbide to water" automatic generators. This I am enclosing. I am quite sure that it is different from anything you have ever seen before. This machine has a series of small buckets which are marked "D" in the illustration. These all have hinged bottoms, arranged so as to drop the entire contents of each bucket at the proper time. These buckets, in operation, are filled with carbide and during the operation rotate around the machine, coming in contact with a trigger trip which allows the contents to drop into the water, where the gas is formed. This gas is then conveyed by means of piping to the inside of the gas holder. With the gas holder full there is no more generating of gas until a certain volume of the gas contained within the holder is used. As the gas is consumed, the holder drops until a point is reached where another bucket of carbide is brought around into position, and its contents discharged. As you will see from the diagram, the gas in the holder is not allowed to go directly into the pipe line. Before this is done the gas must pass through a "purifier," which contains a chemical for purifying the gas. This purifying material must be renewed quite frequently so that the sale of purifying material constitutes quite a business in itself. The use of purifiers seems to be quite general and is occasioned largely because of the many impurities found in the carbide.

There is much I could tell you about the portable equipments, wherein various types of generators are used and many other items which I am sure would interest you. I also have a store of other information relative to welding procedures and welding stunts, but the hour grows very late so I am afraid I will have to wait until next time before going into these matters. In bringing this letter to a close, I wish to extend the Season's Greetings to you and the rest of the gang at Rockford.

Sincerely yours,

SHEP.

CARE OF ACETYLENE EQUIPMENT

The Edward G. Budd Manufacturing Co. in Philadelphia publish a rather interesting little house organ called "Buddgette."

In the December 7th issue, under the heading of "Safety Flashes" their Mr. J. M. Meadowcroft has the following advice to offer on a subject of great interest to the welding industry:

Gas Welding Inspection and Repair

"a—All pressure tanks should be inspected at the close of each day's work.

"b—All hose should be examined weekly by the operators, and in case a defect is found the foreman should be notified at once. It is a rule of this company that defective hose should never be used.

"c—The valves at the base of a torch should be examined for leaks before each operator starts his day's work or lights his torch.

"d—All fire and open lights should be kept away from the gas house.

"e—Water seals should be inspected daily.

"f—Frozen valves should be thawed by hot water or steam and not by flame, or hot metal rods.

"g—Generators should never be left in a freezing temperature unless thoroughly drained.

"Acetylene Generators Should Be Examined and Cleaned as follows:

"a—Flood water chamber and make sure that generator is entirely free from gas and carbides.

"b—Remove carbide hopper, examine and clean float and carbide regulating valve.

"c—Examine and clean purifying screen and tank.

"d—Examine and clean back-firing float and tank.

"e—Examine and clean regulating valves and diaphragms.

"f—Clean out all pipes and connections.

"g—Examine gauge and relief valves and all globe valves.

"h—Do not use a steel bar or wire for cleaning carbide out of generators, nor to loosen carbide in hopper, as these materials might cause a spark, which would result in an explosion

"j—A flashlight should be used while cleaning generators."

A TABLE FOR ELECTRIC WELDERS

R. D. Thomas & Company, 521 Arch St., Philadelphia, Pa., dealers in Electric Welding Equipment and Supplies send out to their customers from time to time a series of very interesting bulletins. One of them which was recently issued contains a table of electrode consumption, which is reproduced. The table illustrates some of the common designs for welding, and gives information on the proper electrode to use for different thicknesses, the weight of electrode material used per foot of welding, the number of feet of welding secured from fifty pounds of electrode material, and the speed of welding under varying conditions.

TABLE OF ELECTRODE CONSUMPTION FOR ARC WELDING

Type of Weld	Thickness of Plate—Inches	Dimensions S	Dimensions M	Electrodes per Foot of Weld—Pounds	Length of Weld per 50 Lb. Electrodes—Feet	Speed of Welding Average Rate of Deposit in Pounds per Hr. 1/8	1/4	2/16	3/8
						Length of Weld per Hr.—Ft.			
90° Single V Weld	1/4	1/16	1/16	.50	100.0	3.8	5.0	6.3	7.5
	3/8	1/16	3/32	.89	50.7	1.9	2.5	3.2	3.8
	1/2	3/32	3/32	1.79	28.0	1.1	1.4	1.7	2.1
	3/4	1/8	1/8	4.31	11.6	.4	.6	.7	.9
	1	1/8	1/8	6.04	8.3	.3	.4	.5	.6
90° Double V Weld	1/4	Double V not necessary on Plates less than 1/2" Thick							
	3/8								
	1/2	3/32	3/32	1.41	35.5	1.3	1.8	2.2	2.7
	3/4	1/8	1/8	2.89	17.3	.5	.9	1.1	1.3
	1	1/8	1/8	4.20	11.9	.4	.6	.7	.9
90° Double Lap Weld	1/4			.26	192.3	7.1	9.5	11.9	14.3
	3/8			.59	84.7	3.2	4.3	5.3	6.4
	1/2			1.05	47.6	1.8	2.4	3.0	3.6
	3/4			2.36	21.2	.8	1.1	1.3	1.6
	1			4.20	11.9	.4	.6	.7	.9
60° Single V Weld	1/4	1/16	1/16	.35	143.0	5.4	7.2	8.9	10.7
	3/8	1/16	3/32	.69	72.5	2.7	3.6	4.5	5.4
	1/2	3/32	3/32	1.18	42.3	1.6	2.1	2.7	3.2
	3/4	1/8	1/8	2.31	21.7	.8	1.0	1.3	1.6
	1	1/8	1/8	3.75	13.4	.5	.7	.8	1.0
60° Double V Weld	1/4	Double V not necessary on Plates less than 3/8" Thick.							
	3/8								
	1/2	3/32	3/32	.90	55.5	2.1	2.8	3.5	4.2
	3/4	1/8	1/8	1.92	26.0	1.0	1.3	1.6	1.9
	1	1/8	1/8	2.74	18.2	.5	.9	1.1	1.4
90° Angle Weld	1/4			.13	384.6	14.3	19.0	23.8	28.6
	3/8			.30	169.4	6.4	8.6	10.6	12.8
	1/2			.53	95.2	3.6	4.8	6.0	7.2
	3/4			1.18	42.4	1.6	2.2	2.6	3.2
	1			2.10	23.8	.8	1.2	1.4	1.8
Straight Butt Weld	1/8 (11 Ga)	3/32		.055	910.0	34.5	45.8	57.3	68.5
	7/32 (9 Ga)	3/32		.060	735.3	27.8	37.0	46.2	55.5
	1/4 (7 Ga)	1/8		.110	454.5	17.1	22.8	28.4	34.1

BOOK REVIEW

ELECTRIC ARC AND OXY-ACETYLENE WELDING, by E. A. Atkins—A practical hand-book for welders, managers, welding operators and students—316 pages, 151 illustrations—cloth bound—published by Isaac Pitman & Sons, New York City, price $2.25. The introductory paragraph furnishes a comparison of the different methods of joining metals, then follows a history of the development of electric arc welding and description of arc welding equipment—instruction for preparing joints and making welds with the electric arc, followed by practical operating instruction. The gas welding section opens with a discussion of the cause and prevention of explosions—then describes the different types of gas welding equipments—tells how to prepare the joints and gives a number of practical points for the guidance of the welder. Cutting by the electric arc and by the gas torch is described briefly, then follows discussions of expansion and contraction—testing welds—selection of filler material and fluxes—crystallization of metals—the welding of wrought iron, cast iron, copper and aluminum. Data and tables concerning different metals and their properties.

WELDER ADVERTISES INSIDE FACTS

Charles Hausser, proprietor of the North Albany Welding & Repair Works, believes in going after business by sending out circulars to selected lists of people who should be using his service. His circulars usually take the form of a letter on his regular business stationery. In these letters he states to his prospective customers how necessary it is to have important welding jobs done by expert operators, how easy it is for the welding shop to save valuable parts of machinery from the scrap heap. He also explains how fully his shop is equipped for all kinds of repair welding, what kind of service he can give, and how well his customers appreciate his work. He also explains that prices are based on the cost of time and material used, regardless of the skill required on the value of the piece salvaged. These letters contain a whole lot of useful information which is very well known to welders, but which is not so well known to the public, and Mr. Hausser says that he finds it is a profitable thing to keep sending it out.

A CONVENIENT GRINDER FOR WELDERS

A convenient portable electric grinder for welding shops which use the metallic arc process has been developed by the Wodack Electric Tool Corporation, of Chicago. This grinder is specially wound to operate from the welding circuit so that it will be available for duty at any point regardless of whether there is a plug available for tapping the shop circuit at that point or not. It is especially convenient for operation with gasoline driven motor generator arc welding sets, since it allows grinding to be done before or after welding with such equipment without the necessity

Portable Grinder Works From Generator.

for having an air compresser on hand, as is the case with pneumatic grinders.

The illustration shows one of these grinders in operation in one of the largest welding shops in Chicago. It will be noted that one of the leads to the socket to which the grinder is connected is held by the electrode holder and the other one is attached to the ground lead of the generator. The flexibility of this little tool is quite a convenience in this case because the welding machine is of a portable type and the grinder is always available for duty regardless of the location of the work.

INCREASES PRODUCTION SEVENTY-FIVE PER CENT.

Illustrating the Value of Service Given in Special Cases in Response to a Need Made Known by the User

The management of a large plant in the Mississippi Valley manufacturing steel window sash had about come to the decision that their welding costs were so high that to continue the use of this process in production would not be profitable. One of their principal products is a steel window sash fitted with a ventilating section which is fabricated by oxy-acetylene welding. The cost of welding these parts averaged 9c. per weld which includes handling the material before and after welding, the actual labor cost of the welding operation and the cost of the gases and supplies used. The management was convinced that this figure was too high but they were at a loss for a means to reduce it.

Not being favorable to the thought of abandoning oxy-acetylene welding for this work, it was decided to submit the cost problem to an oxy-acetylene engineer. They were convinced that the welded joint was the proper one to use and were anxious to continue welding the windows if economically possible.

At the request of the plant management an oxy-acetylene engineer called and made a careful survey of conditions. He studied each operator's method of welding and the manner in which he used the blowpipe. The welding rods and the gas pressures were carefully checked. He then made a careful time study of all of the operations connected with the fabrication of the welded parts, from the time the pieces to be welded were delivered at the welding station to the point when the welded sash was moved on to the next operation.

With the cost factors thus determined the oxy-acetylene engineer suggested that a helper be used to place the component pieces to be welded in a jig so that a minimum amount of time on the part of the welder would be necessary. He also recommended that the oxygen and acetylene pressures be reduced, and that the operators' methods of handling the blowpipe and the welding rod be slightly changed.

All the suggestions were promptly put into effect. The operators were enabled to handle many more individual pieces per hour than they had handled before. A reduction in gas pressures not only resulted in an immediate saving by cutting down the amount of oxygen and acetylene used per hour, but also softened the flame and thereby made easier the control of the molten metal, the latter permitting increased speed of production on the part of the operators. The operators were thoroughly instructed in a method of using the welding rod in making a smooth weld and were taught how, by working the welding flame away from the thin edge of the metal parts, they might overcome the difficulty they had previously experienced of having the molten metal on the edge "run away." This one revision in the operators' methods also saved rejections in finished products as well as time and gas, and in addition enabled them to make a better appearing weld.

The operators willingly put these suggestions into effect as they appreciated that greater efficiency on their part would increase their own earning power.

While the advantages of increased production and lowered cost impressed the other members of the organization the superintendent was not convinced that the operator's new method of welding, which was so much more rapid than the old one, would result in a weld sufficiently strong to meet the requirements. To prove to him that his fears were unfounded several "run-of-work" welds were tested by clamping them in a vise and bending them back and forth to a 90° angle three times. All the welds tested stood up under this very severe treatment and the superintendent was thoroughly convinced of the quality of the welds made by the revised methods.

Service in this case resulted in very great savings to the company. The production of the welded frames was increased about 75 per cent, this aiding to reduce the cost per weld and in addition enabled the manufacturer to better supply the demand for his product without increased labor or capital investment.

As a result of the service rendered production welding of the steel window sash continues as one of the plant's major operations, and oxy-acetylene welding is more thoroughly intrenched in the production schedule now than it ever was. —*Oxy-Acetylene Tips.*

The orders received by the General Electric Company for the year ending December 31, 1923, amounted to $304,199,746, compared to a total of $242,739,527 for the year 1922, or a gain of 25 per cent, according to a recent announcement by Gerard Swope, president of that concern. For the fourth quarter of 1923, orders totalled $74,452,442, as compared with a total of $66,568,333 for the corresponding quarter in the year 1922, or a gain of 12 per cent.

The Welding Engineer

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The Best Instruction May Also Be the Cheapest

SEVERAL trade schools which have discontinued or decreased their instruction in Gas Welding have indicated that this step has been taken on account of the high cost of giving this instruction. Undoubtedly the cost item which has been most burdensome has been the cost of the gas used. A number of other schools are giving long courses of instruction in this trade and signify their intention of continuing it because of their success with it and the continued demand for men trained in the use of the torch. The cost of a welding course is not prohibitive if the instruction is conducted along the right line. It does become prohibitive when welding students are allowed to devote a great deal of time to playing with the torch and burning gas in an aimless fashion. The principles of flame adjustment can be learned just as well with a very small tip and correspondingly small gas consumption as with a large tip. The same thing applies to the study of the effects of the different flames. It is not necessary to take a large torch and melt a large amount of metal to find out what happens when a carbonizing flame is used. Neither is it necessary for a student to spend all his time manipulating a lighted torch to get the most out of his instruction. Some men who have had long experience in the training of welders insist that the student should be entrusted with the torch as little as possible during the early stages of instruction. They also recommend that the time spent in school furnishes an excellent opportunity to get the student welder into the habit of testing his own welds and comparing them with samples of perfect work. An instruction of this sort is not apt to prove too expensive for the ordinary trade school, and is likely to produce a better grade of welding operators.

Train Your Own Welders If You Can

AN instructor in one of the finest welding schools in the country points out that the Plant Manager or Superintendent can give the Welding Operator a lot of good co-operation; that he must in fact give this co-operation in order to get the best results from his equipment. As a matter of fact, the Plant Manager needs to go still farther than this in order to realize to the fullest extent the investment which has been made in apparatus. There are hundreds of workmen in this country who did a little bit of welding during the war who have not followed welding continuously as a trade since that time, but who do not hesitate to apply for jobs in the welding departments when they cannot find work at their own trade. Even if these men are given the benefit of the doubt, and we do take it for granted that they are willing to follow the welding trade, it is poor business to put them to work without making some provision for giving them a thorough training in the fundamentals. One of the best methods of recruiting workmen for the welding department is to establish a systematic apprenticeship system in the shop, allowing helpers who have been in close enough touch with the welding operations to know that they want to learn the work, to take a certain amount of time each day for an extended period and receive instructions from a competent teacher. Instruction of this sort needs to be as nearly uniform as possible to accomplish the best results. The more uniform it is, the better the Welding Supervisor will be able to judge the ability of the apprentice when he is put on the pay-roll as a welder. In the case of large plants, where the welding department is of good size, it is not a difficult matter to arrange such a system of inside training, and such procedure is altogether in line with up-to-date principles of plant management. In the case of smaller departments, it would be worth while to provide for assisting a new welder to secure outside instruction for a long enough period to make sure that he really understands the principles of the trade.

The Birthplace of Prest-O-Lite Service Indianapolis, 1904

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PREST-O-LITE was the first to conceive and put into operation the idea of a nation-wide chain of service stations.

When the Oxy-Acetylene Process made its entry into American factories, Prest-O-Lite Service was already a household expression.

Today, 28 plants and 44 warehouses supply this one universally used gas for both welding and cutting in convenient portable form. And 1924 will see further additions to Prest-O-Lite facilities.

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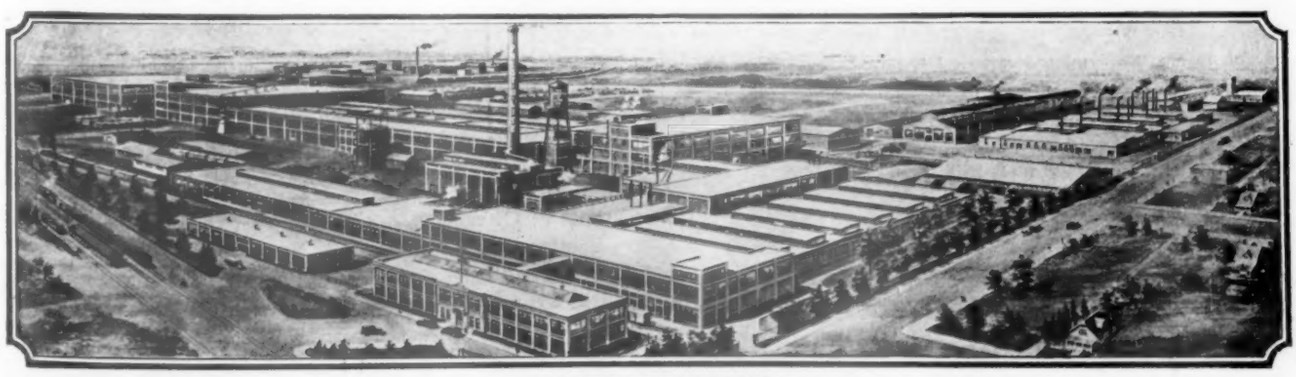


TWENTY YEARS AFTER

G. P. A. WINTER MEETING

The program arranged for the widwinter meeting of the Gas Products Association is such as to assure good attendance and lively interest. It will be held at the Blackstone Hotel, Chicago, January 17, 18 and 19. Following is a list of the subjects:

"A Study of the Oxygen-Oil Explosion Hazard"—Dr. M. D. Hersey, Physicist, U. S. Bureau of Mines.

"Cost Accounting"—C. R. Stevenson, President, Stevenson Corp.

"What Kind of Chemicals Does the Oxygen Industry Want?"—C. W. Brown, Manager, Innis Speiden & Co.

"Fire Insurance for Oxygen Gas Plants"—Mr. Leonard Peterson, Special Agent, Home Insurance Co.

"Group Insurance for Members of the Gas Products Association"—H. E. Tank, Travelers Insurance Co.

"What Co-operative Buyings Has and Can Do for Our Members"—Horace N. Smith, Secretary, Memphis Oxygen Co.

"Accomplishments of the Insurance Committee"—A. J. Russell, Secretary, Bettendorf Oxygen Hy. Co.

"What the Educational Committee Has Done, What It Intends to Do, and How You Must Help"—H. S. Card, Associate Editor, Welding Engineer.

"Cylinder Turnover"—W. H. Ballance, President, Electrox Co.

"Sales and Service"—Parker B. Francis, Secretary, Kansas City Oxygen Gas Co.

"Liquefaction Plant Operation"—E. H. Smith, Secretary, Commercial Gas Co.

"The Future of the Oxygen-Hydrogen Digest"—W. L. Brant, Secretary, Indiana Oxygen Co.

"Cylinder Marking"—Chas. L. Gulick, Wm. Wharton, Jr. & Co.

"What We Have Learned About Liquefaction Plants"—E. G. Luening (our greatest traveler).

"Accident Prevention"—J. T. McGaughey, Vice-President, Clarke Chemical Co.

"Profit Sharing With Employes"—W. F. Verkamp, Secretary, Ohio Electrolytic Oxgen Co.

Motion Picture Showing How Oxygen Cylinders Are Made.

A feature at the banquet, which will be held Saturday evening, January 19, will be Mr. E. H. Smith's liquid oxygen act. He has had many calls to present this act, and is said to be the only member who "made the first page" of a metropolitan daily newspaper (unless there was an explosion) and positively the only member to have his picture on the front page.

CHICAGO SECTION HAS INTERESTING MEETING

The January meeting of the American Welding Society, Chicago Section, was held Friday evening, January 4th, in the Auditorium of the Western Society of Engineers.

Mr. C. W. Roberts, welding supervisor of the Pennsylvania Railroad at Columbus, Ohio, read a paper entitled "Getting Results Economically by Electric Arc Welding." In this paper Mr. Roberts emphasized the importance of having the different welding processes available whenever possible so that each job could be handled by the process which would give satisfactory welds at the lowest cost. He cited several examples of repair jobs where there was a distinct saving to be made by selecting the process which would make a good weld at the lowest expense. It was also pointed out that there are a great many uses for the carbon arc which are commonly overlooked and that in some cases the carbon arc gives the best results at the lowest cost. He also showed how boiler welding can be done to better advantage and more economically if the correct procedure is followed for handling the material. A number of lantern slides were shown to illustrate the points made in the paper and to show the difference between good welding and bad welding in the boiler work. Mr. Roberts' paper was the subject of a lively and interesting discussion, since it covered many points which were apparently of considerable interest to all the members present.

The second paper on the program was on the subject of "The Production of Oxygen by Air Liquefaction Process," by D. B. McCloud, associated with M. Keith Dunham, of Chicago. Mr. McCloud described the two methods of producing commercial oxygen and then by means of lantern slides took his audience through an air liquefaction plant and explained every step in the production of oxygen by this process. Following this talk, Mr. McCloud produced a large container full of liquid oxygen and, by showing its effects on various substances, demonstrated the extremely low temperature at which it was produced.

C. G. M. A. MEETS THIS MONTH

The following program has been announced for the Compressed Gas Manufacturers Association eleventh annual meeting and dinner in New York this month:

January 21st, 1924:

10:00 A. M.—Meeting of Chlorine Manufacturers at office of Association, 120 W. 42nd St.

10:00 A. M.—Meeting of Acetylene Manufacturers at office of International Acetylene Assn., 30 East 42nd St., 22nd Floor.

2:30 P. M.—Eleventh Annual Meeting of Association at Hotel Astor, Broadway and 44th St.

7:00 P. M.—Eleventh Annual Dinner, Hotel Astor.

January 22nd, 1924:

1:00 P. M.—Meeting of Oxygen Manufacturers beginning with with a luncheon at Hotel Astor.

2:00 P. M.—Meeting of Carbonic Gas Manufacturers with Mfrs. of CO_2 Refrigerating Machinery and Representatives of Mellon Institute at Yale Club, Vanderbilt Ave. and 44th St.

January 23rd, 1924:

10:00 A. M.—Meeting of Nitrous Oxide Manufacturers at office of the Association.

"LETTERS FROM EUROPE"

French Welding Equipment

BURDETT COMPANY ANNOUNCES PLAN OF EXPANSION FOR 1924

The Burdett Oxygen Company of Chattanooga, in keeping with industrial activities in the state of Tennessee and adjoining sections, has purchased one acre of land in the Lonsdale section of Knoxville. Construction of a $100,000 plant for the manufacture of liquid oxygen will be started immediately after January 1st, according to plans announced by H. B. Pearson, Vice-President of the Company. The Burdett Company's plants in the Alton Park district have been running at full capacity during the past year.

The new oxygen plant at Knoxville, which will be completed by June 1st, will be modern in every detail and will serve the Company's growing list of customers in Eastern Tennessee and Kentucky, Southwestern Virginia and Western North Carolina. Cheaper oxygen and better service to Knoxville users will result from the establishment of the plant at that point, according to officials of the Company. The sales office of the Company, located at 1270 Market Street, Chattanooga, is under the management of Mr. W. P. Hendricks.

A SOUVENIR FROM I. O. C.

The International Oxygen Company, of Newark, N. J., is distributing a neat little vest-pocket memorandum book, which contains a great deal of useful information for the user of compressed gases. The range of subjects cover: The Properties of Oxygen, Hydrogen and Acetylene; The Application of Oxygen, Hydrogen and Acetylene; Laws Governing Gases; Standard Conditions of Pressure and Temperature; Chemical and Physical Properties of Gases; Composition of the Atmosphere; Effect of Oxygen Purity on Cutting Speed; Ratio of Oxygen to Acetylene in Cutting; Temperature of the Welding Flame; Heat Units of Various Gases; Welding and Cutting with Gas; Variations of Pressure in Standard Oxygen Cylinders at Various Temperatures; Approximate Cost of Cutting with Oxygen and Acetylene per foot of Cutting Length; Approximate Pressures with the Rego Cutting and Welding Torches; Handling and Storage of Cylinders, and Protection Against Heat, Grease and Oil.

Hints for the Welder

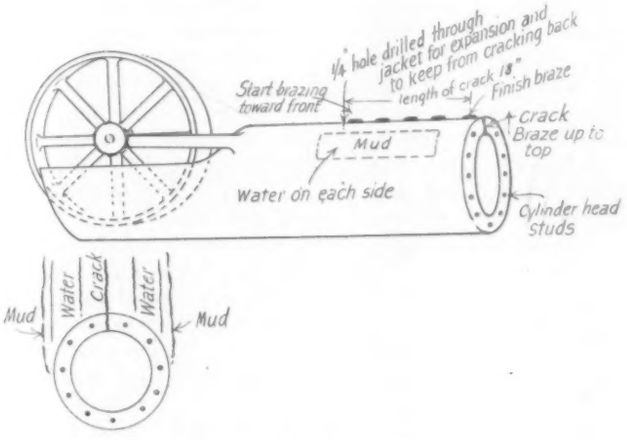
When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way – I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today – the men on the firing line are waiting. L. B. Mackenzie, Editor.

A WATER JACKET REPAIR

By C. M. Johnson

Some time ago I was called out to look at a 90 horsepower gas engine which had a cracked water jacket. We figured that it would take about two days to dismantle this engine and about the same time to assemble it after the crack had been welded. So, of course, a four-day shut-down would have been necessary. This engine pulls a large compressor for a gasoline plant, so I looked around for a way to make the repair without going to all the trouble of taking it down and hauling it two miles to the shop.

The crack was about 18 inches long and was on top, running out to where the head bolts on. I had the head taken off, then in-



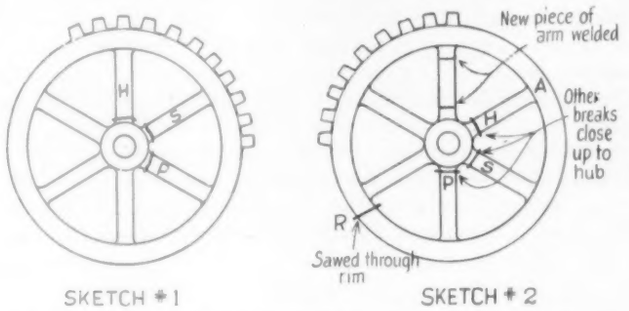
Details of Water Jacket Repair

structed my helper to vee out the casting which was ¾ of an inch thick, leaving about ⅛ inch at the bottom not beveled. Then we drilled a ⅛ inch hole a little beyond the end of the crack. We built up around the sides of the cylinder with mud and poured in water to keep the heat from radiating. For the filling material I used a ¼ inch tobin bronze rod and brazed a strip 1 inch wide, expanding over the vee about ¼ inch on each side, and building up on top about the same amount. Then I started on the face and came straight up. When it cooled down I faced it where the head bolts on with a keen chisel and file. When we put the gasket on and bolted the head on, it did not leak a drop. The owner was more than pleased because this job was done in less than three hours, and it would have taken a week to dismantle it, bring it to the shop, weld it and replace it. The engine has been in service for some time and shows no sign of giving any further trouble.

AN EARLY EXPERIENCE IN WELDING GEARS

By George Reed

During the early days of my welding career, my superintendent gave me instructions one morning to weld a cast iron gear wheel which had been broken in three places as shown in the sketch. This was one of the first big jobs that had ever been handed to me and I was a little confused. Although I had never been taught the principles of preheating, I knew that it was necessary to follow some such procedure, and, therefore, made arrangements to preheat the whole wheel. My preheating device was made by bending a 1¼ inch pipe into a circle, drilling a quarter inch hole about every inch, putting a plug into one end and attaching an air hose connection and a globe valve in the other end. The gear wheel was laid on the ground outside of the shop and a wood fire built between the spokes and around the rim. Then we opened the valve and let a little air fan the fire. It was a regular comedy. All my pals sneaked around the first chance they got and the foreman had the time of his life keeping those young fellows corraled. We soon found that we had too much help and too many suggestions, so the gang was chased away and all attention was turned to the job. The gear was getting too hot around the rim and constantly increasing the gap at the break as the wheel expanded, so we shut off the air and tried another foolish stunt. This time we raised the gear from the ground about 2½ inches on bricks, then right under the wheel we put three pipes with holes in them for air and built another fire of



Showing Where Breaks Occurred and How They Were Welded.

wood and turned on the air. We added green blacksmith's coal over the wood until just the top of the gear arms could be seen. We had a hot fire, and were feeling quite pleased until I suddenly missed one of the arms. On shutting off the air we found that the air blast directly under the wheel, and too close to it with insufficient ventilation, which caused one arm to melt away except four inches at the rim and two inches at the hub. On top of that it happened to be one of the good arms that was gone, thus leaving only two good ones out of six.

The next thing to do was meet the superintendent who fortunately was a fair-minded man. I want to interrupt my story here by stating that I have always found it a real good policy to tell the boss the absolute truth. I stuck to this policy to this day and have never had cause to regret it. In this case we told him exactly what had happened and he told us to take it to the scrap pile and he would order a new one. The boys joked with me about the gear in the scrap pile for a long time, but I was bound that this would not be the end of the wheel if I could help it. Shortly after this I purchased and read thoughtfully some of

the publications on oxy-acetylene welding and did my best to apply the principles contained in them to my work. I was the only welder for miles around, so there was nobody from whom I could ask advice on such troubles.

Two years after the above experience I walked up to the same superintendent and asked him if he would give me another chance to weld that gear wheel. He looked very much surprised and asked me what reasons I could give him for feeling that I could weld the gear successfully, explaining that oxygen and acetylene cost quite a little money when the freight was considered, and he did not want to waste it if he could avoid it. After thinking a few moments I said that I had more experience and improved technique. This pleased him and he gave me permission to go ahead. By this time the gear wheel was red with rust. I brought it right into the shop where everybody could see it and started right away to bevel off the stubs of the arm which had melted away. We beveled these on both sides, hunted up another broken pulley, took an arm of the same size and after beveling both ends and sides, fitted it into the gap. It seemed to fit O. K. so we welded in the arm at both ends on one side and then reversed it and welded the two vees on the other side. The other three broken arms had allowed us ample allowance for expansion and contraction without any preheating. We let the wheel cool during the lunch hour and finding it in good shape in the afternoon, we started to saw through the rim at the point labeled "R" in the second sketch. This relieved the stresses which had previously been set up and which had caused it to become slightly distorted. After cutting the rim, the three breaks H, S and P were beveled on both sides. The first weld was made at "S." This was welded from each side successfully. I was afraid to get the gear unevenly heated, so we did not weld any more that day, but left it to cool. Next morning everything seemed to be O. K. so we started in and welded "H" while another torch handled by my helper was played on and around "A." After welding "H" on both sides, I played my torch on the rim at "R" and traveled upwards to the other torch at "A" in order to offset the contraction. After promising the superintendent that I would weld the gear on my spare time, it was necessary to put it aside at different times in order to tackle other jobs which were needed, so it was two days before I could go back to it and finish it. This time after beveling out both sides at "R" from the edge of the rim and between the two of the tooth, we made a real good weld. For the last weld, the helper played his torch on the rim and I welded at "P" from both sides. Then we played the two torches on and near this weld and shut our eyes waiting for it to crack. But it didn't crack, and it hadn't cracked when I left there.

Since that time some very difficult jobs have come my way and my experience has convinced me that it is a good thing for a young welder to be left to his own resources, because if he fails momentarily, if he is made of the right stuff, he will eventually become a good welder.

WHEN WELDING FAILS

In the following letter to *The Iron Age*, R. K. Randall, instructor of welding in the Cleveland School of Technology, gives users of welding equipment some excellent advice on the subject of co-operation with the welder:

"The average firm using welding for production has long recognized the importance of ideal welding conditions, but the average foundry or factory which uses welding to reclaim broken parts or save defective castings certainly should see that their foreman investigates more thoroughly the application of welding to their various problems.

"In the average plant of the last-mentioned class we usually find the welding in charge of the shop foreman or master mechanic. He is usually well educated in problems of every sort except welding. Welding as a rule is forced upon him; the firm buys an outfit and hires a welder, and of course the welder has to recognize someone in authority as boss, so the master mechanic or the shop superintendent automatically assumes the role.

"Welding is new to him, and if he happens to get a good welder for the first one he readily sees that remarkable things can be accomplished. He accepts this result as a matter of course, rarely stopping to think or reason why. The fundamentals such as fusion, neutral flames, fluxes, pressures, selection of tips, proper care of regulators and torch, the expansion and contraction, the cause of a hard cast iron weld, and many other things which enter into the work, are never grasped by him.

"This state of affairs usually goes on until some unusual job comes up for which the welder needs some special equipment, such as firebricks, flux, special wire, or charcoal, or any one of the many things that are often needed. The "boss" knows nothing of the vital importance of these things and tells the welder he can get along without them. The welder has two courses he can follow. He can go ahead and spoil the job, or he can quit. A good welder will usually quit rather than tackle a job he knows he is not equipped to handle. Of course some other welder is usually hired who will tackle the job thinking only of his "so much an hour," and thus add another failure against the process of welding.

"I am going to cite three little instances that were recently brought to my attention, to illustrate my point.

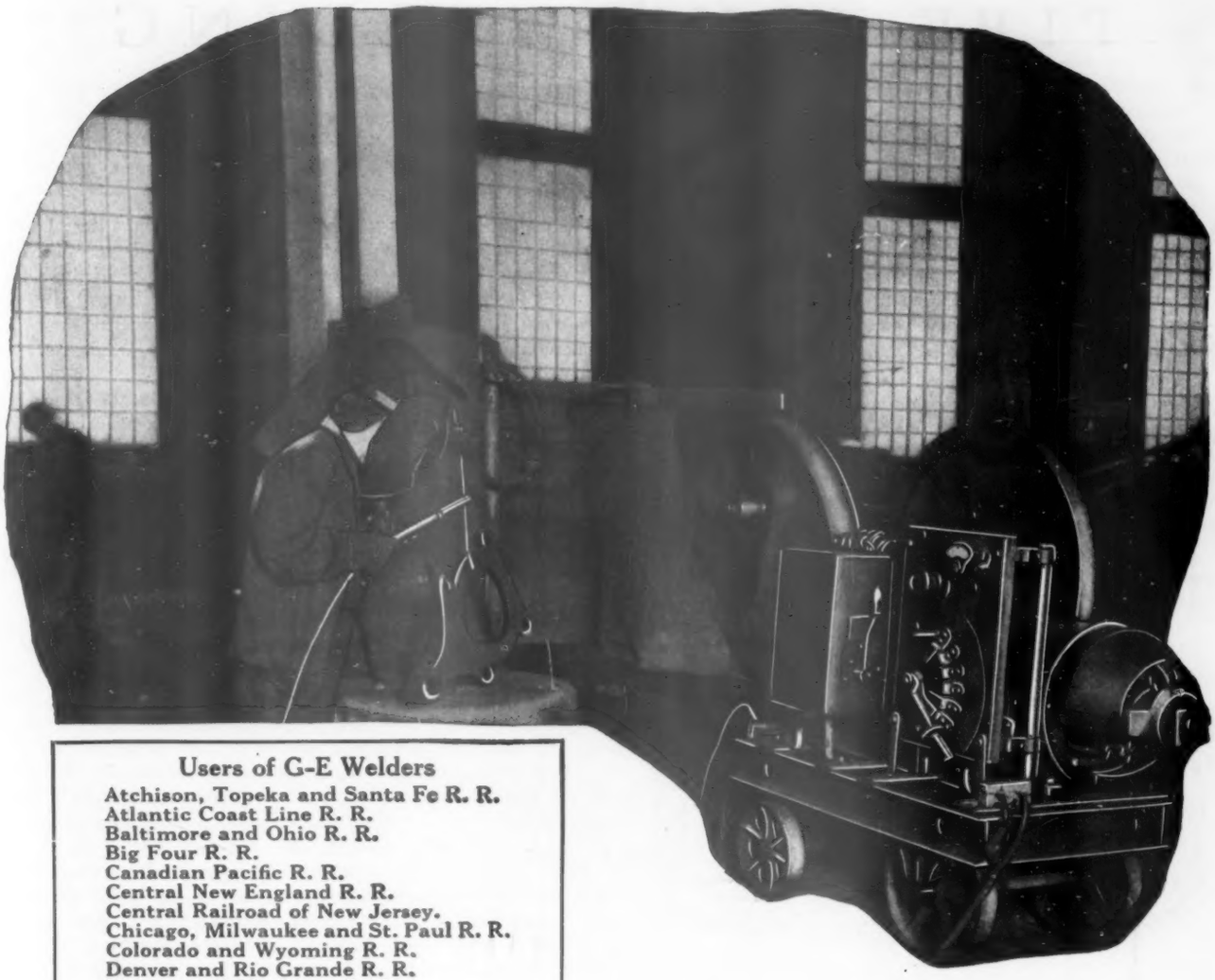
"A certain large firm ran into a small aluminum proposition that needed some small shrinkage cracks and blowholes welded, so they bought equipment and expected a man to successfully weld the small castings on a barrel out of doors. Another concern wanted some wrongly machined castings built up to size, and offered the welder no chance to preheat them, then found fault because the welds were hard. Another firm had a cast iron pot to be welded, the welder preheated the pot, and after welding carefully covered it over to prevent shrinkage cracks. After the welder had gone out to some other part of the plant to another job, the shop foreman, who was in a hurry for the pot, uncovered it and allowed it to cool too quickly and then found fault with the welder who did the job because it cracked. These three instances show how little the average man in charge of a shop knows about welding.

"A firm which expects to get the most out of its welding should first get the services of a first class, experienced welder and then realize that the welder needs all the help and co-operation he can be given. The welder knows his needs and will not ask for anything that is not necessary. Today nearly any public library has many books and magazines on the subject of welding, and every man who is responsible in any degree for the success of welding in his shop should equip himself with a reasonable knowledge of the art of welding.

"Welding associations and manufacturers of welding equipment are today trying hard to send into the field high grade, intelligent welders, equipped with all the proper knowledge to produce good welds, but after obtaining this knowledge it avails them little if the firms for whom they work do not do their share toward helping them in every way to carry out the theories so essential to a successful weld. R. K. Randall."

HOLD YOUR GOOD WELDERS

IN THE larger cities it is noticeable that the demand for welding operators is often very seasonable. At certain times of the year it is almost impossible to secure an operator who knows anything at all about good welding, and at other times there seems to be an epidemic of laying off men who are really first-class operators in spite of the efforts of the head of the department to hold the organization together. A real good operator means so much to the efficient operation of the welding department that it is a great mistake to let one of them go in order to secure a temporary reduction of the overhead expense. When you turn a good man loose you are never quite sure that you are going to be able to replace him. If you have a good welder, and know he is a good welder, hold onto him. If you let him go he may be hard to find when you need him again.



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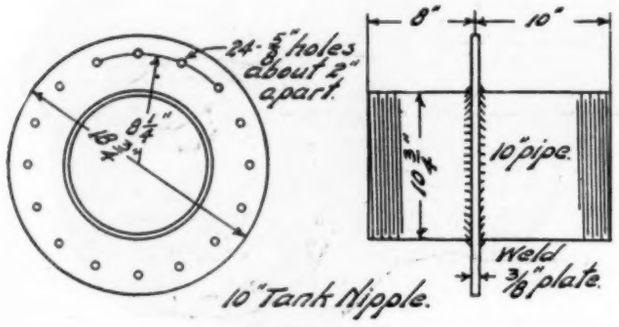
PIPE LINE WELDING

A Review of the Progress Made in Pipe Line Welding During 1923—Development of a New Method for Welding Ells

By N. E. Wagner

AFTER reading a paper before this Convention about a year ago on the subject of "Oxy-Acetylene Welding As Applied to Oil Carrying Lines and Pumping Stations" I have been asked by the Directors of this Association to prepare and read another paper on the subject of "The Developments in Pipe Line Welding During the Past Year."

In opening I wish to inform you of some of the developments which we have made in welding work, during the past year, for the Prairie Pipe Line Company. I will first mention the number of miles of welded pipe line laid by this company since the meeting of this Association last year. Since that time we have laid 107 miles of 8 inch and 34 miles of 6 inch welded line. These lines were all laid as loop lines from one station to another, or from one station to gate house or junction point. These loop lines ranged from 8 to 34 miles in length. In welding or laying this amount of pipe, in loop lines, the work was distributed throughout our pipe line system and carried on and developed in Missouri, Kansas, Oklahoma and Texas. Some of these lines were laid in cold weather and some in mild weather, while others were laid in extremely hot weather. I will mention here that our last loop of 17 miles of 8 inch welded line was laid in Texas during July and August of this year at which season the temperature varied from 100 degrees to 112 degrees in the shade nearly every day. It was necessary on this job to make a large canvass shade to fit over a quarter inch pipe frame to protect the generator from the direct rays of the sun. It was also necessary to supply each welder with a large umbrella to shade him while welding. In all the 107 miles of 8 inch and 34 miles of 6 inch line comprised seven different jobs or loops. On testing out all these lines before putting them in actual service we found only one defective weld. In my opinion, and I believe you will all agree with me, this is a very good percentage of efficiency in the development of pipe line welding.



Welded Flange Tank Nipple

In addition to our regular pipe line welding we have, in the past year, welded approximately 3,500 feet of extra heavy pipe for discharge lines on various station grounds from the pumps to the manifold house. Some of these lines were 8 inch and some 6 inch, while on one particular job we welded approximately 1,000 feet of 12 inch. We have also made up all our ells, tees and forged steel flanged connections for these jobs by the oxy-acetylene process.

In regard to the ells which we made up for these lines I wish to call your special attention to a two section 90 degree ell which we developed in the past year. We have had some of these special ells in service on discharge lines, where vibration and pressure are greatest, without a single failure up to the present time. In making up this ell we make a double "V" cut in pipe leaving from three to four inches of pipe stock on the back side of the ell and and a center section of any desired length. We then heat the pipe where the three or four inches of stock remains and bend the ends up to close the "V" cuts, which forms a 90 degree angle. We then weld at the two points where the "V" cuts join together after bending. When these welds are completed we take a piece of ½ by 1 inch flat iron and place it edgewise, or with the narrow side to the pipe, on the back side of the ell so that both ends extend over the "V" cut about three inches. We then weld this strip to the ell on both sides which makes a reinforced finn on the back of the ell. We also apply one of these strips to each side of the ell in the same manner. Then we proceed to weld a brace of ½ by 2 inch iron or a piece of split pipe from one run of the ell to the other. This we call our reinforced ell for high pressure service. I believe this special reinforced ell is of great value to any one doing high pressure work or where there is much vibration. Our reason for developing this special ell is due to the fact that we had a couple of failures on common welded two section ells on our discharge lines at pump headers where pressure and vibration are greatest.

We have also welded several liners for railroad crossings. As you will doubtless remember I mentioned in my paper last year that it was necessary that these crossings be put in according to railroad specifications. On these jobs where new railroad beds were being built, on account of double tracking, it was necessary to lengthen the liner through which the main oil line runs. We figured that in these cases it would be expensive to shut down stations to cut the line in order to slip the liner on the pipe. Furthermore it would have been impossible to drain the line at these points from stations. The result of cutting the line would have been a loss of oil with consequent risk to many people on trains passing these points where oil had been spilled over the right-of-way. We then decided to split the liner pipe in halves and place these over the oil line and reweld the half sections of pipe. This we did without any trouble or loss of oil. Also without the necessity for shutting down the stations.

We have replaced many creek crossings during the past year in different districts by welding, which seem to stand up better than screwed lines at these places.

We have made repairs on a number of miles of old lines through alkali grounds and by the first of the year, or sooner, we anticipate that we will have covered and made repairs to approximately 75 miles of eight inch lines, in welding up pit holes and welding new sections in the line, with the oxy-acetylene process.

During the past year we have installed heating systems for reclaiming lubricating oil at stations by welding hot water heaters and piping which heat the oil to a high temperature before it goes to the centrifugal reclaimer and filters.

We have continued to construct welded pipe buildings during the past year by utilizing and welding second hand or junk pipe. The most important have been two pump station buildings each 40 by 50 feet; one warehouse and shop building combined with dimensions of 50 by 125 feet; one tool house building 24 by 48 feet, and some smaller buildings for manifold houses, garages, etc.

At present we are preparing to go ahead with a job which we consider a mark in the advancement and development of pipe line

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**Paper read before the International Acetylene Association at Chicago, November 16, 1923.*

†Welding Superintendent, Prairie Pipe Line Company.

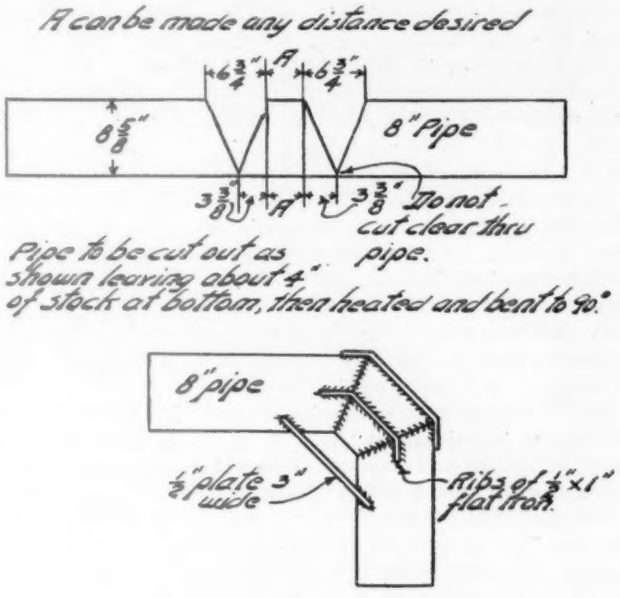
welding, that of welding two lines across the South Canadian River near Pauls Valley, Oklahoma. These lines will be of extra heavy 8 inch pipe and will be between 7 and 8 thousand feet each in length. It has always been customary in laying pipe lines across rivers to place heavy cast iron clamps at each joint to protect the coupling, if screwed pipe was used, and up to the present time we have also used clamps on welded lines. We are now planning on using plain end pipe and making good reinforced welds, with four pieces of ½x1x7 inch flat iron strips over the circular weld, spacing these at quarter points on the pipe so that each strip will extend about 3 inches each side of the joint from the circular weld. This additional reinforcement to the weld is made in order to withstand any extraordinary strain which might be brought to bear upon the pipe during the flood stage of the river. These reinforcing strips are applied in the same manner as on our reinforced ells. After the three or four joint sections, necessary to cross the channel, are welded, we expect to pull these sections across, making our tie-up welds in the same manner, and lower the line in the river without clamps of any kind.

If any of you are familiar with the South Canadian River, you will agree with me that it is the most treacherous stream which we have to cross with pipe lines. Several pipe line companies have lost all their lines across this river while we have been fortunate in not losing our lines entirely, but we have had several bad breaks. We have one 8 inch screwed coupling line and one 8 inch welded line across the South Canadian River at present. Both of these lines have broken at different times. The welded line has now broken three times and upon making repairs we find, upon cutting off the old welds, that these are defective, not being fused to the bottom of the "V" of the bevel. In the construction of our new line we expect to have closer inspection of all welds, so that every one may be made perfect. In our opinion this will eliminate any future trouble from lines breaking in the above mentioned stream, although this will have to be proven by actual test, when the South Canadian goes on a rampage, caused by flood waters. If we are successful in welding these two lines so as to avoid any breaks during the flood stage, we will not only have saved the company a great amount of money, by preventing a loss of oil, but will also make a great saving by discontinuing the use of the river clamp. These clamps are purchased in the open market at a price of $25.00 per set for regular weight clamps and $35.00 per set for extra heavy clamps. These prices are regulated according to the price of scrap iron used in moulding them. By eliminating the regular weight clamp, it will mean a saving of approximately $9,300.00, or $13,000.00 for extra heavy clamps. This does not include railway transportation cost nor the time and labor saved in handling and placing these clamps on the line.

Although the breaks in welds on the South Canadian were caused by defective work, all but one break was in light pipe, which at the time the line was laid, was not in the regular channel. The river, however, cut away the bank thus changing the channel, and undermined the line, causing it to break, as light pipe was used.

After having advised you with reference to the South Canadian River, I also wish to give you some information regarding the North Canadian, which in that part of the country where our lines are laid, is a smaller stream than the South Canadian, but almost as treacherous during the flood stages. About the middle of October of this year and at the same time when we were having trouble with the lines breaking on the South Canadian heavy flood waters broke through on the North Canadian causing the stream to cut a new channel approximately one-half mile from the former main channel. This new channel was about 300 feet wide and 20 feet deep at a point where three 8 inch screwed lines crossed. This washout, therefore, left the three 8 inch lines suspended and the swift current and drift wood completed the work of breaking all three lines. They were washed down stream and caused a complete shut-down until we were able to get welders and material on the job to replace them with a temporary crossing. We constructed this crossing by cutting off the couplings and threads and making a complete welded job in a very short time after the flood water had receded. In making repairs to these lines it was necessary, after cutting off threads and couplings, to weld up a 300 foot section and pull it across the channel. This was a somewhat difficult job due to the swiftness of the current and the long welded section of pipe. However, after making the tie-up weld on the south bank, we filled the line with water for additional weight and aided by a large gang of men, the bends were made so that the pipe contoured to the bed of the channel. After this part of the work was finished, the final tie-up weld was made on the north bank and the job was complete. I mention this point in order to give you some idea of the severe bending stress we sometimes produce in welded joints.

The Prairie officials are now planning to order sufficient plain end river pipe for all three lines across the North Canadian to permit laying them from the south bank of this new channel to the


A can be made any distance desired
6 3/4"
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6 3/4"
8 5/8"
8" Pipe
3 3/8"
A
3 3/8"
Do not cut clear thru pipe.
Pipe to be cut out as shown leaving about 4" of stock at bottom, then heated and bent to 90°
8" pipe
1/2" plate 3" wide
Ribs of 1" x 1" flat iron

Details of Reinforced Welded Ell.

north bank of the old channel, thus making an entire welded job.

We have completed several new stations this year, making the majority of our connections and fittings by welding and are also applying the oxy-acetylene process in making and installing special units of various kinds on station work.

We have developed what we term, a flanged tank nipple. You will understand that it is necessary to place one or more connections on storage or works tanks. On large tanks, ranging from 3,000 to 55,000 barrels capacity, we usually have two or three connections. It has always been customary to purchase flanged tank nipples, or threaded tank flanges, and use a long thread nipple running through to the inside of the tank to support the swing pipe ell. The flanged tank nipple is made with any size nipple desired, usually ranging from 6 to 10 inches in diameter, and 18 to 24 inches in length, with the tank flange riveted and caulked to the nipple at about its center. The threaded pipe flange, as previously described, is used by screwing a long thread nipple through the flange. These flanges are riveted to the tank at desired points for line connections. In making our welded flanged tank nipple, we take a piece of flat tank iron, or boiler plate, and cut the outside circumference for the flange and then the inside circumference to fit over an ordinary pipe nipple 24 inches long. We weld this circular flange to the pipe nipple at about its center, welding both sides of the flange. This we find is a very cheap and convenient method for making flanged tank nipples. My attention was especially called to this fact on a rush job in Texas, during the past summer, when our company wished to put a tank

in service and had no tank nipple on hand. We immediately took a common nipple and a piece of tank iron and made one on the job in a short time, thus putting the tank in service without any delay.

We have also done considerable manifold welding at several of our stations during the past year. The most important one was a completely welded manifold at our Argo Station, near Neodesha, Kansas. This manifold consisted of 6, 8 and 12 inch headers and was a very successful job.

We have been asked several times whether or not oil passed through welded lines more freely than through screwed coupling lins. We have no way of determining this point but we feel more confident in crowding or forcing the welded line up to full capacity than we do the screwed line.

We have also been asked regarding the elimination of the "line-walker" on welded lines. This company has deemed it unnecessary to use a "line-walker" on an all-welded line when such a line is separate from other lines. There is one line fulfilling these conditions in service for the Prairie Pipe Line Company. This is the Mexia-Hensley 8 inch line constructed about two years ago from Mexia to Hensley, Texas, a distance of 140 miles. The other welded lines which we have laid run along the right-of-way with screwed lines and as it is necessary to employ "line-walkers" to cover screwed lines to repair collar leaks, they inspect all lines on their respective routes.

All the above mentioned line and pipe development work has been done throughout the Southern Division of the Prairie Pipe Line Company. The Northern Division of the company, or the portion extending from Humboldt, Kansas to Whiting, Indiana, also has taken up welding work more extensively during the past year. We have shipped three large generators, with all necessary equipment, from the Southern Division to the Northern Division to enable them to carry on their work.

Having received a letter, dated at Kansas City, Missouri, from our General Superintendent Mr. C. E. McPoland of the Northern Division, pertaining to some of their most important welding work during the past year, I will be pleased to read it to you:

"We have laid 23 miles of 8 inch pipe on the Northern Division, one loop out of Carrollton and one out of Humboldt. The loop out of Carrollton, up to the present 'slow-down' was operating at 700 pounds line pressure and passed through one winter. Up to date we have never had a leak reported, or have repaired a leak in this loop. This is also true of the Humboldt Loop.

We have adopted the plan upon all changes of lines in small towns and cities through which we pass to use the plain-end welded joint. In this respect we have changed seven 8 inch lines through the town of Lexington Junction, Missouri, for a total of 3.3 miles and are now just completing the changing of four 8 inch lines through the city of Marceline, Missouri, and will change the line through the town of Bucklin, Missouri, in the same way, all with welded pipe. Next year we figure on changing the four 8 inch lines through the city of Dallas, Illinois, using welded joints. In this town we have lines laid in the main street.

This all leads up to the point that everyone connected with the pipe line end of the business believes, that a welded line is the best and most satisfactory job from a leak point of view, and particularly where there is a hazard to dwellings and business places which would be endangered from collar leaks and escaping oil.

We have never laid any 12 inch plain end pipe. However, we are starting a small job west of the Wilbern, Illinois, station and have the plain 12 inch pipe on the job. At Salt Creek on account of lowering lines to an unusual depth, we replaced 1,200 feet of screwed pipe in this ditch with 1,200 feet of welded pipe.

When we have casing to extend on railroad crossings of the Santa Fe and other roads where the original casings on old lines was not extended to the proper distance to meet requirements, in putting on the additional casing, we split the joint, welding it back as a solid joint around the line and welding the end to the present casing, making proper extension to this casing without disturbing or cutting the main line and without any loss of oil or interference with operation.

We are using the welding process upon all broken lines as far as possible, which lines formerly were flanged and later the system of right and left collars installed.

We have been doing a number of small jobs around stations for some time, welding shields, covers and all classes of small repair parts for machinery, stairs, railings, etc. We are also welding all short pieces of pipe around stations, welding up pitted pipe, etc.

In a recent job in making up a large connection of field tanks at Humboldt Station where we have a large delivery system from Argo Station and a large suction system at Humboldt Station we practically eliminated all screwed and flanged fittings formerly used, by welding all branches and lines to tanks. Every day brings forth some new and particular job where welding is practical and economical. On our pumping units we build up shafts, pistons, etc., turning them down and making them as good as the original part. In other words, we are doing about the same work you are doing on the Southern Division, but not perhaps on as large a scale.

We are also figuring on having a man who is capable of making a first-class weld at each station along the line and tour men, working at the station, who will make first-class men for repairing leaks and breaks east and west of the station. When not employed on repair work and line work of this kind, the tour men will be regular employes at the station.

Everything seems to be working out very well. We are building up our organization and have a number of men who are foremen or assistant foremen who have taken a great interest in their work and who can hande a generator and make a first-class weld."

From Mr. McPoland's letter you will note that the Prairie Pipe Line Company has also made much progress in the Northern Division during the past year.

In addition to welded pipe line work developed by the Prairie Pipe Line Company I wish to inform you of some of the most important welded line work which has been done by other companies. My reason for being interested in pipe line welding of other companies is due to the fact that we have supplied some of these companies with men from our organization, and also with blue prints giving information of our methods of making up different units, and the system which we have adopted in laying welded pipe lines.

I will first refer you to a letter from one of our former employes, Mr. C. J. Murphy, who has been on welded line work in the Wyoming field.

I am informed by Mr. Murray that the Mid-West Refining Company has laid two 3 inch gasoline lines from Salt Creek to Casper, Wyoming. One of these lines was laid in 1917 and the other in 1922. These lines have never given any trouble and are the only lines in the Salt Creek field that did not break during the flood of six weeks ago.

The Mid-West Company has just completed 42 miles of 10 inch welded line. Although this line broke during the flood period, the break was due to the pipe bending to such an angle that the pipe buckled. Mr. Murray has been on several jobs for the Prairie Company when lines were laid over very rough country, but he informs me that the Mid-West Company's 10 inch line was laid through the roughest country in which he had ever seen pipe line laid.

He also states that they had considerable trouble in finding welders and that it was necessary to break in many new welders on the job. This line tested out with only three small leaks, which, in my opinion, is a wonderful example of the success accomplished in the development of pipe line welding.

Several other companies have laid welded lines of various sizes in the Wyoming field with good success. Mr. Murray states that most of the large companies in this field show preference to welded lines and that during the coming year we will hear of more welded lines in this field than ever before.

I have also been informed by officials of the Sinclair Pipe Line Company that they have developed more pipe line welding during

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the past year. They have welded river crossings, built welded manifolds, welded connections on new stations and used the oxy-acetylene process to good advantage on various kinds of work in connection with pipe line construction, all with good success.

The Gypsy Oil Company and the Gulf Pipe Line Company, operating in the Mid-Continent field, are very much interested in the oxy-acetylene process of welding. These companies have, in the past year, laid 15½ miles of 6 inch welded oil carrying line using the same system as adopted by the Prairie Pipe Line Company. This work progressed successfully and the line tested out without any leaks and proved to be a very satisfactory job.

They have also done considerable welding work in the past few years in constructing gasoline plants and vacuum lines. In making scrubber tanks, for gasoline plants, they use the barrels of old discarded boilers by welding heads in them and welding on all necessary connections. These tanks are then connected to plant lines giving just as good service as new tanks purchased for that purpose.

I have been informed by an official of these companies that they have developed welded work more extensivly during the past year. They have welded many useful units which are used in and around their pump station buildings, such as welded protector hoods over inlet pipes to oil and gas engines, welded ladders and platforms for use around engines and pumps, treatolizer tanks for supplying chemicals in proper proportion to line of flowing oil, many kinds of special fittings, and small ten by eighteen tanks made from old 10 inch casing for use in connection with the pricumicator used for measuring the amount of oil in 55,000 and 80,000 barrel tanks without going from the station to the tank to make gauge.

They have also reclaimed much old pipe during the past year by welding up short pieces to long lengths and welding up holes in perforated casing for use in line work when repairing.

All the previously mentioned units have been made up from second hand or junk material at a marked saving to these companies. These units are made up and handled through the Material Department of these companies, which department has charge of all welding work except line construction work, and during the progress of such work this department cooperates with the Pipe Line Department in furnishing welders and equipment.

A few oil and gas companies located in California have inquired regarding our system used in making up various welded units and also as to how we organize our gangs for laying welded lines. Through such correspondence we have learned that these companies are much interested in developing welded work more extensively due to the fact that they have had good success in welded work as far as they have progressed.

I have been informed that welded line work has developed quite extensively throughout the entire state of California during the past year. Many new water lines, gas lines and welded oil carrying lines have been constructed due to the recent development of new oil fields in this state.

Before bringing this subject to a close I will mention a few points which might be of particular interest.

The first point which I will call to your attention is the cost of laying welded lines during the past year as compared to the cost of similar lines which were laid a year or two previous. At present we do not have cost data on all welded lines laid during the past year but on those upon which we have data we show a reduction on the lay cost. The reason for this is that our organization has been kept together each one working with much interest in trying to do the best work possible. We are also continually developing new ideas in order to improve our system and keep the lay cost to the lowest possible point.

In making repairs to broken oil lines laid over ordinary right-of-way and more especially in river beds we have been very successful in completing such repairs by the oxy-acetylene process which is a cheaper and quicker process than the old method of using flanges, cutting threads, or using right and left nipples. If the line break should be in a river bed, or a place where there is much excavating to be done, we simply dig a hole down to the break large enough for a welder to work in, and then cut out the section and weld in new pipe of the desired length. In making a repair of the same nature by using the old method of screwed flanges or nipples, it would be necessary to do much more excavating, which would require additional time and labor.

In the development of a welding organization the efficiency with which that body functions as a whole or individually, is responsible for the ultimate success of the organization. The continued calls from various districts throughout our system for welders to do certain classes of work enables us to hold as a minimum ten or fifteen welders. These men are trained along lines in which we have had the most success, such as laying lines, station work, manifold work, making buildings, etc. These men are continually striving to gain the highest point of efficiency in their work, and on starting a welded line job we are able to pick our foremen from this group. With sufficient welders added to make a full gang, we are able to start the job and carry on the work, without any delay in building up an organization prior to laying the usual amount of pipe per day.

Upon the completion of some of our welded line this past year, the Prairie officials were very anxious to start transporting oil at once. We, therefore, eliminated the water test on a couple of jobs and turned the oil into the line as soon as completed, building up the average pumping pressure and transporting oil through the line without the delay of making the water test. This point brings out the fact that our officials are satisfied that the welded line is a success, and also speaks highly for the efficient work of the welder. Another interesting point here is the saving made in eliminating the water test which is very expensive at times on account of the scarcity of water which means additional equipment and time to secure the necessary water to make the test.

These few points bring out the fact that pipe line welding, when developed on an organized basis, is advantageous from an economic standpoint.

In addition to the welding work developed by the specific companies mentioned in this article, many other gas, oil, pipe line and refining companies have taken up oxy-acetylene welding more extensively during the past year in the Mid-Continent field. We learn of some of the development which other companies have made through conversing with welders who are traveling from one job to another, but it would be almost impossible to get complete data on these jobs from each and every welder with whom I come in contact. Furthermore, if it were possible, it would take up too much valuable time at this meeting to give you details on welding done by all companies using the oxy-acetylene process in the Mid-Continent field. I have, therefore, confined this paper to the most important work which has been accomplished and hope that the contents of this article will be of interest and benefit to all concerned in the development and progress of oxy-acetylene welding.

BUSINESS CONDITIONS TODAY

According to the current business bulletin of La Salle Extension University, some business men are inclined to be a bit pessimistic over the fact that 1924 is a Presidential election year. They entertain a loose traditional idea that all such years are naturally bad for business. This year, however, there already are some indications that the sentiment of the country in general is tending to crystalize into definite expectations concerning the outcome of both the nominating conventions next summer and the election returns next fall. It appears now, therefore, that this element of uncertainty in the general situation during 1924 will be less of a major factor in shaping business conditions during the year than it has been in some other election years. There is no doubt, however, that uncertainty as to the outcome of the election will be sufficient to have some influence in maintaining the conservatism that has characterized business as a whole during the past half year or so.

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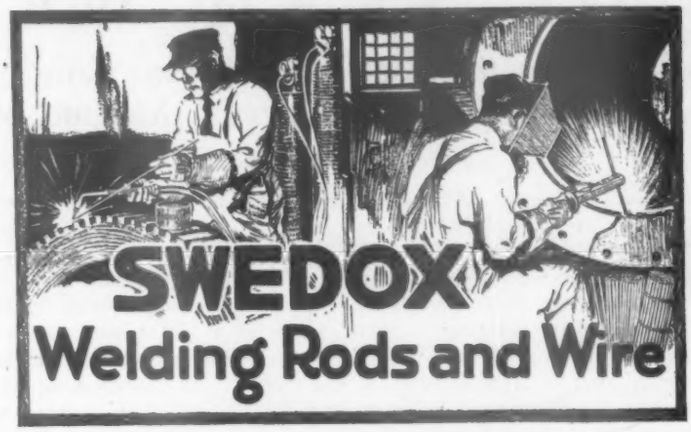

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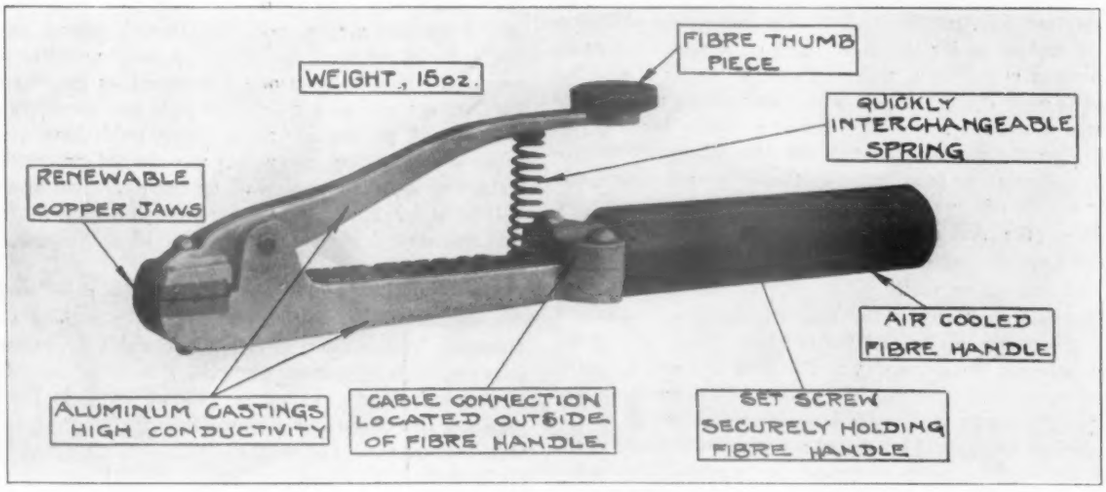
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TYPES OF SEAM WELDERS*

Characteristics of Automatic Spot Welders and Continuous Welders—Roll-Step Method and Interrupted Current Method of Seam Welding

By J. R. Bruekner†

THE first practical demonstration of the so-called Resistance Method of joining metal was made as early as 1886 by Elihu Thomson. Since then the Butt Welders and Spot Welders have become most useful machines. We are not concerned, however, in this review with the progress of Butt Welding machines, a large chapter in itself, but intend to follow briefly the development of the first simple Spot Welder to the present Seam Welder.

The principle of forcing an electric current of high value and low pressure or voltage through the joints of comparatively high resistance made by two metals is the same in the case of Butt Welding, Spot Welding or Seam Welding.

The simple essentials of a Spot Welder are a transformer properly housed, having a secondary capable of carrying a heavy current without heating, an upper and lower welding horn provided with suitable welding electrode, preferable water cooled, and a mean of applying pressure to the weld which is made between the welding electrodes. The welding cycle itself is simple, thus: first, the sheets to be welded are placed between the electrodes—sufficient pressure is exerted to bring the sheets into contact with each other. The primary circuit of the welding transformer is closed causing a high amperage welding current to flow in the secondary, the sheets are heated to a plastic state because of the resistance to the flow of current at the point of contact. The current is then switched off and a final welding pressure completes the cycle.

Simple in principle, the Spot Welder is a practical and most efficient tool in the metal industry today. Nevertheless, a constant process of refinement is going on.

Improvements in transformer design, water cooling of electrodes, automatic switching devices and pressure arrangements and last but not least more adaptable electrode arrangements are being brought out almost daily.

The Spot Welder's usefulness ranges from the single spot which takes the place of a rivet on say a small fixture to the series of spots closely made to take the place of a seam welded by Oxy-acetylene on Auto Bodies. In the latter case a narrow strip is first welded under the Butt Joint of a seat back seam, then the joint is closed by a series of spot welds made so close as to overlap each other. When power hammered and ground this produces a smooth seam of sufficient strength for the job.

The desire on the part of Sheet Metal Manufacturers to produce a leak and pressure proof seam by the resistance method and without the aid of either soldering or tinning, etc., has led to the development of the Automatic Spot Welder, Continuous Seam Welder, Roll-step Method of Seam Welding and Seam Welding using the interrupted current.

In the automatic spot welder the pressure is applied by means of a motor driven mechanism and the operator simply moves the work along between the electrodes at the desired rate of speed. This method is fast and conserves the energy of the operator, but is limited to light gauge work with but few exceptions.

The continuous Seam Welder shows a decided difference from the Spot Welder. The point electrodes are replaced by copper welding rolls, a driving mechanism is provided and the work is moved between the rolls at considerable speed. The welding current is on during the time that the rolls are moving the work. This at once shows a decided departure from the accepted procedure of spot welding in that the current is not switched off, thereby providing a cooling or setting period for the weld. It is for this reason that only short seams of very light gauge of carefully cleaned, pickled or ground stock can be successfully welded.

To remedy this drawback of unreliable welds another—the so-called Roll-step or step by step method (patented) was next employed in line welding machines. In appearance these machines resemble the continuous Seam Welder, inasmuch as welding rolls are used. The change, however, comes in the driving mechanism, which consists of an eccentric actuating a pawl and ratchet arrangement. This means that the driven welding roll moves periodically and the whole cycle is now this: as the roll comes to rest the current is automatically switched on, causing the metal to be heated to a plastic state, then the current is automatically switched off. The pressure of the water cooled welding rolls squeezes the material into a homogeneous union and tends to solidify the weld. The roll then moves a fraction of an inch to the next step. When the rolls come to rest the same welding cycle is repeated. It will be noticed that during the time the rolls are in motion and when the work is moved between the rolls there is no current flowing.

This patented principle proved a decided advantage, inasmuch as heavier gauge material could be welded and a careful cleaning of the stock was not necessary. It might be of interest to mention that the claims made for these machines that they will weld one-pass stock are not to be taken seriously from a production standpoint. Anyone familiar with spot welding will know that with the proper pressure and heat a single spot weld can be made successfully on one-pass material. At the same time, experience proves that it is not a practical production proposition, chiefly because frequent cleaning of the electrode points in necessary, since the oxide of the sheet will imbed itself into the copper. The reason for this is that the contact between the copper and the top of the sheet is so imperfect, because of the oxide, that almost as much heat is created at this point as between the sheets. This brings the surface of the sheet to a semi-plastic state and also heats the copper, and, therefore, it proves an easy matter for particles of steel and oxide to unite with the copper under pressure. This is frequently augmented by the fact that the surface of the one-pass sheet is rough and considerable arcing is experienced, particularly after a few welds have been made. In other words, unless the points are cleaned practically with each weld, the sheet will be pitted or burned. The welds themselves will be of no value, as far as strength is concerned, for the reason that the oxide is imprisoned in the weld, preventing a clean metal to metal union.

Since the roll-step method, as can be seen from the above description of the welding cycle is really nothing more than an automatic spot welder, it is not reasonable to suppose that one-pass stock can be successfully welded in production. There is however, less careful grinding or pickling required for this method than for the continuous line welding method. This disadvantage with this method lies in the slowness with which the work is performed.

A fair average of speed for this machine would be about 150 feet per hour. As much as 180 feet per hour are obtained on the lighter gauges and on heavier stock the speed drops below 100 feet.

The seam (line) welding machines operating on the current interrupters principle are similar to the continuous seam welders in that the welding speed is high and no strain is put on the mechanism by the abrupt stopping and starting of the welding roll. They combine with this, also, the features of the step by step method in that the current is interrupted rapidly.

Paper read before American Welding Society, Chicago Section, Dec. 7, 1923, by E. S. Hurd, Chicago Manager, Gibb Instrument Co.

†*Chief Engineer, Gibb Instrument Co.*

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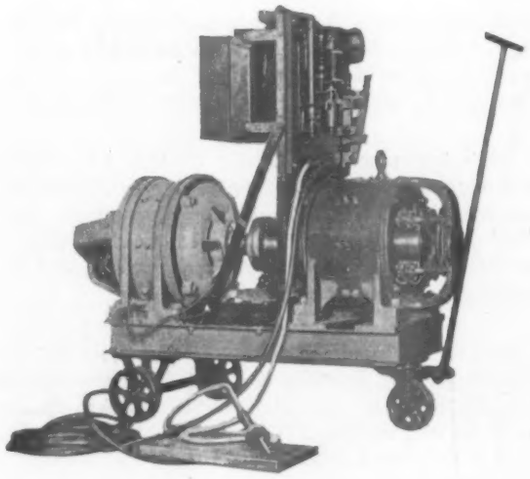

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This permits a surge of welding current and a subsequent cooling period. To go back for a moment to the continuous Seam Welder, when the current is continuously applied and the work is subjected to the welding pressure, the stock is frequently burnt and pitted when sufficient heat is created to make a weld. On the other hand, if the current is reduced to a value which will not injure the metal, the metal is frequently only sweated or insecurely stuck together. On the contrary, with the interruption of current burning and pitting is entirely eliminated. Any comparatively clean sheet with the exception of the heavier gauge one-pass stock can be welded with this method.

The machines are automatic in their operation, that is, the current is automatically switched on and off and work requires no more than guiding by the operator along the seam. To describe this machine, would say that in appearance it resembles a large size spot welder, that the standard type machine is of 30 KVA capacity, having its transformer mounted within the base casting. A laminated secondary connects to upper welding wheel directly and to the lower welding horn. In the standard machine, the upper welding wheel is driven by means of an electric motor mounted at the top of the machine. The speed of this motor is reduced through worm gears and a set of change gears. These change gears provide different speeds at the welding roll for different gauges of material. In the standard machine provision is made to quick change the roll arrangement from the straight seam to the circular seam, in other words, the side seam of a container can be welded and by simply changing the lower arm which is held in a sleeve, and swiveling the upper roll ninety degrees, it is possible to also weld the bottom of the container into the shell.

The electric interrupter is actuated by a commutator driven from the motor by means of a round belt. The number of interruptions per minute can easily be changed by shifting the belt on the cone pulley.

It is obvious that for pressure tight work at a high rate of speed, a greater number of interruptions are desirable. The interrupter method has proved successful for iron and steel sheets as well as monel metal, nickel, brass and zinc. The limits of the standard machine are No. 16 gauge steel sheets and No. 22 gauge brass sheets. Successful welds have been made on coated sheets, galvanized or terne plate, not heavier than No. 24 gauge. While heavier gauge coated sheets can be welded, the welds are less reliable in production because of the uneven coating of the sheet. In other words, if the rolls pass over the sheet at a point where it is more heavily coated than at another, the resistance at that point varies. Consequently, the heat at this point will be different and the weld will not be uniform.

A further disadvantage in welding coated sheets lies in the fact that the coating will adhere to the copper rolls and the heat in welding the heavier gauges is so great that the spelter is burnt into the copper forming a hard crust which is detrimental to the flow of current. Frequent cleaning of the rolls would overcome this difficulty, but this entails a considerable loss of time. It is hoped that in due time effective cleaning devices may be put on the roll, eliminating this objection, but at the present the machines are not recommended for the heavy gauge coated sheets.

The speed with which the work can be welded by the interrupter method varies somewhat with the thickness of the gauge, but 20 gauge pickled stock can be welded at a speed of five feet per minute. The strength of the weld is easily that of the original stock. Tests have been made where welded containers would stand a pressure of 2,000 pounds per square inch.

The design of the machine is very important with the various classes of work. Frequently, the work travels between two rolls as in the standard machine. For a certain class of work, again, an arbor is provided which travels below the welding roll or the work is held over a mandrel and the roll travels along the seam. The method adopted depends entirely on the size of the work and whether it is more efficient to have the work move or the roll travel with the work held stationary. The seam welding machines of the interrupted type can be used successfully in the manufacture of lead kegs, paint cans, and containers of this kind, also railroad torches, oil cans, reflectors, mufflers, refrigerators, gasoline tanks, radiators, etc.

The manufacture of welders of this kind is to a great extent an engineering proposition, although a good many machines have been built and have become standard with the manufacture of this machinery.

News of the Welding Trade

MEMPHIS OXYGEN COMPANY EXPANDING

The Memphis Oxygen Company, of Memphis, Tenn., is erecting a new Air Liquefaction Oxygen Plant with a capacity of 700,000 cubic feet monthly, and which will cost in the neighborhood of $50,000.00. It is expected that the plant will be completed by March 1st. The company also expects to have in operation an Acetylene Gas Manufacturing Plant before the middle of the new year. The expansion of the company is due to the rapid growth of Memphis, which has caused an increase in the use of the oxy-acetylene process. L. B. Lovitt is President of the company, and Horace N. Smith is Manager.

The California Compressed Gas Company, of Oakland, California, secured an excellent contract for supplying gas in connection with the reducing of the battleships Rhode Island and Georgia to scraps. Newspaper reports estimated the gas required at ten million feet.

At a meeting of the Executive Committee of the Gas Products Association held January 5, 1924, the following were elected active members:

Gas Products Company, Columbus, Ohio.
International Oxygen Company, Newark, N. J.
International Oxygen Company, Toledo, Ohio.
International Oxygen Company, Verona, Pa.
Southern Oxygen Company, So. Washington, Va.

Associate members:

American Brass Company, Kenosha, Wis.
Pittsburgh Generator Company, McKeesport, Pa.
Weldit Acetylene Company, Detroit, Mich.

A handsome calendar has been received from the Maryland Welding Company, Baltimore, Md. It is large enough to be read at a considerable distance and is beautifully printed. Certainly a good advertisement for the welding shop.

The Gibb Instrument Company, of Bay City, Michigan, manufacturers of electric welding equipment, announce the appointment of Mr. Glenn A. Wilson as manager for New York and New England territory, with headquarters at 120 Liberty street, New York. Mr. Wilson formerly represented the Mutual Electric and Machine Company.

The plant of the Empire Electric Welding & Repair Co., foot of Thirty-sixth Street, Brooklyn, N. Y., is being remodeled by the W. & A. Fletcher Co., 1301 Hudson St., Hoboken, N. J., who will use it for ship repairing.

It is reported that C. E. Johnson, of Chicago, Ill., is planning to build a new welding shop at 9363 Ewing Avenue.

MILBURN WELDING AND CUTTING APPARATUS—New catalogue just issued by the Alexander-Milburn Co., Baltimore, Md. This is a convenient pocket sized catalogue of 24 pages, illustrating and describing the Milburn line of acetylene generators and portable oxy-acetylene welding outfits—cutting torches—welding torches—combination torches—repair goods—regulators—preheators—acetylene lights—welding rods and fluxes. The Milburn Company also published a catalogue of the same size describing its line of portable acetylene lighting equipment, and in this catalogue has included data and information regarding its Milburn Welding and Cutting Apparatus.

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FRAME MAKING AND REPAIRING

Application of the Oxy-Acetylene, Thermit and Electric Arc Processes in Repairing Locomotive Frames—Methods of Handling Expansion

AT the twenty-seventh annual convention of the International Railroad Master Blacksmiths' Association, which was held at the Hotel Sherman, Chicago, on August 21st, 22nd and 23rd, the following papers on the practice followed in frame making and repairing on various roads were submitted by C. H. Nutter, Boston & Maine, North Billerica, Mass.; G. W. Kelly, Central Railroad of New Jersey, Elizabeth, N. J.; and T. F. Buckley, Delaware, Lackawanna & Western, Scranton, Pa.

C. H. Nutter:

With the added facilities for autogenous welding at the present time, the repairing of frames has been reduced to a question of which method to use to get the best results at the least cost.

The introduction of the mechanical cutting torch enables new frame sections to be made from hammered steel billets, the most intricate shapes being cut and ready for use in a very few hours. New sections may be cut in such a way as to practically eliminate machine work except for shoe and wedge fits of jaws, cylinder fits and thickness of sections. Other parts can be cut to size, annealed and sent to the machine department in a very short time as compared to the old method of forging.

We are using the following kinds of welds: Oxy-acetylene, Thermit and electric and have no difficulty handling any one of them in a satisfactory manner.

It is useless for any of us to say that we do not have any failures. No matter what method is used, there is sure to be a certain percentage of failures, but it behooves the foreman blacksmith to so train his men who handle this class of repairs as to make this percentage as low as possible. The accompanying table shows welds made and how made in the year 1921 at the Billerica shop.

Kind of weld	Total number made	Number failures	Per cent
Oxy-acetylene	161	11	6.83
Thermit	37	6	16.2
Electric	7	1	14.3
	205	18	8.77

When I speak of a failure, it does not mean that the weld proper breaks, but should the frame break near the weld or in such a manner that the weld was responsible for the break, such as improper expansion, improper methods, etc., it is called a failure. It is customary to run an engine into the shop to have a frame welded and there is not always time enough given to strip it in such a way that the proper expansion can be obtained. It, therefore, is not unreasonable to expect that the frame will break soon after its return to service. The total actual failures as shown in the table would have been only seven had the welds broken, for in 11 of the cases they broke at a point away from the weld which could not, therefore, be classed as failures in the strict sense of the word.

We keep a complete record of every weld made, who made it, and the date; also a sketch of the weld with a record of whether the expansion was perfect or not. We also stamp the welds made at the different points, with the shop mark carried at that point where weld is made and the date of making.

There are so many factors that enter into the breaking of frames, such as poor design, loose and improperly fitted shoes and wedges, loose binders, worn pins, loose rod wedges, loose bolts in frame braces, and last but not least, poor road bed, that we should have the co-operation of everyone from the lowest to the highest official, to bring the percentage of breakage as low as possible, and to keep locomotives in service.

We are applying new sections of a heavier design to such classes of engines on the Boston & Maine as were giving trouble, also adding frame tie castings where needed with very satisfactory results.

As proper expansion is essential to a good job, every effort should be made by the man in charge to see that the proper amount is given. In the case of acetylene welding, there are no two operators who use the same amount of expansion, as some weld faster than others, and great care should be taken in mating up the men to get the best results. Also, special training should be given to the men selected to weld frames, and a close check kept on their welding, to see that they are actually welding and not just filling in the vees. They should weld test pieces often and be shown the results of the tests. If the tests prove unsatisfactory they should be told why it is unsatisfactory, and should prove it for themselves by welding another piece for test purposes. No matter what process is used, only the most experienced men should be used at all times.

G. W. Kelly:

The fact that the manufacture of locomotive frames has passed altogether into hands of the steel foundries which co-operate with the railroads in making frames of correct design and proper analyses does not relieve us of that most important duty of keeping frames in service. Steel frames have weaknesses as well as the wrought iron frames which they superseded and it requires quick decision as to the best method to effect repairs to return the locomotives to service with the least possible delay. We now have the use of Thermit, oxy-acetylene and electric welding processes and it has been proven unnecessary to remove the frames. Since 1905 the Central Railroad of New Jersey has used principally the Thermit process and has made several hundred welds which made a permanent repair.

There were many long discussions when the Thermit process was first introduced. At that time there were many failures and there are still some today, and there will continue to be failures where the operator does not exercise the proper care on the several points, which govern the making of a successful weld. We cannot emphasize too strongly the importance of proper allowance for contraction, particularly on the heavy sections where it is most difficult to obtain it.

By using long heats of charcoal on opposite rails or pedestals, we have practically eliminated the use of a spreading bar or jack. The latter must be used with the greatest care, whereas the uniform heating of all the rails with charcoal allows a natural contraction which may be timed with the contraction of the weld without tension or buckling in the welded rail or other members of the frame.

The perfect drying out of the mold, sufficient pre-heating and the proper timing of the reaction will insure a perfect weld.

T. F. Buckley:

A discussion on frames at this time should treat largely on the changes that have come through the substitution of cast steel for wrought iron. In cast steel a frame can be made much stronger than one of wrought iron as there are many brackets and braces cast integral on the frames which eliminate the bolting that is necessary when these parts must be fastened separately to wrought iron frames. It is now the aim of the mechanical departments to combine such braces as guide yoke knees, brake fulcrum brackets, reverse lever brackets, crossbrace knees, etc., solid with the frames. This practice can readily be followed with cast steel frames and the necessity for drilling for these braces is thereby eliminated. The plan with the cast steel frame strengthens the frame and reduces the liability of breaking.

In reference to the repairs required on main locomotive frames,

we find we have more repairs to be done on wrought iron than on cast steel frames. The cast steel frames used on our heavier power engines have given us very little trouble. Our percentage of breakage on these frames is very small, the most frequent being the cracking away of the pedestal binder toe below the driving boxes.

We have been making repairs to locomotive frames for the past several years by electric and oxy-acetylene welding, the majority of repairs being made by the latter method, and have been getting good results from such repairs. We find the best method in repairing frames by acetylene gas is by using two torches, one on each side of the weld, until the work is finished. We cut all the welds in V-shape, to an angle of about 45 deg. and make sure that the scarf is clean where the weld is to be made. It is very important in making the weld to provide for proper expansion, this being difficult to describe as it is governed by the design of the frames and location of the weld. It is also necessary to have capable, experienced welders on this class of work. As previously stated, we are getting satisfactory results from the oxy-acetylene welding, but have also been well satisfied with results obtained by the other welding processes, notably the electric.

The largest percentage of frame repairs is on our older engines, built 12 or 15 years ago and having light section wrought iron frames. We have not generally removed any frames from these engines for welding during the past several years, but have made all repairs while the frames are under the engine. We find that in making welds under the engines, that at times it is difficult or impossible to provide for the proper expansion and contraction. We may think we have the correct length, yet when the weld is completed find we have thrown strains elsewhere which may later cause other failure of the frames. It is the writer's opinion that when several welds have been made under an engine in one frame section that when this particular engine is in the shop for general repairs, the frame should be removed, sent to the blacksmith shop for annealing and have the old welds examined. If necessary they can be worked over and all strains removed and the frames made to the proper dimensions in all particulars. Unless this is done good permanent results will not be obtained.

WELDING SCHOOLS GIVEN VALUABLE ASSISTANCE IN PERFECTING INSTRUCTION

The work of the Educational Committee of the Gas Products Association takes the form of a general movement to render personal service to Principals of Welding Schools and Welding Instructors, through the medium of representatives and service men in the territories served by the various schools.

The committee has adopted a schedule of instruction which covers the knowledge and skill to be acquired by the student welder to make him a satisfactory apprentice at this trade. The Association recommends a definite amount of instruction to be given in the school, and offers assistance in arranging courses to cover the amount of ground indicated. In cases where the stipulated amount of instruction is given, the name of the school will be placed on an Accredited List. Every effort will be made to decrease the cost of instruction in Accredited Schools by supplying apparatus and gas at the lowest possible figure; to provide desirable positions for graduates from these schools, through the recommendation of representatives who are in touch with the needs of employers, and to secure students for these schools by solicitation, and by advertising. The co-operation given to welding schools is not limited to those on the Accredited List of the Association, although in the case of such schools extra effort is made to help maintain the standard of instruction at the highest possible level.

The committee is prepared to render personal service in all cases where it is requested. By means of special bulletins, the committee will furnish all schools which desire such service, with information and suggestions on the conduct of a training course, and act as a clearing house for ideas which will be helpful in this work.

ACETYLENE SLUDGE EJECTOR

A means for easily disposing of the sludge or residue from an Oxweld acetylene generator has just been installed at the Pere Marquette shops, Grand Rapids, Mich. Originally the sludge was drained from the generators into a concrete cistern just outside the generator building. The cistern is 8 ft. square and 6 ft. deep with an overflow 8 in. square, located about 18 in. from the top. Periodically the sludge was bailed or dug from the cistern and carried away in wheelbarrows over several tracks to a point about 150 ft. away where it was dumped. Aside from the labor required to move the sludge, the overflow for carrying away the excess of water, frequently became clogged and caused trouble.

A cylindrical tank, formerly in use for oil storage was found which was about 6 ft. long and 5 ft. in diameter and was placed in the cistern. The 2-in. drain from the generators was fitted with a gate valve and connected to the bottom of the tank and carried out under the tracks to the dump. A ¾-in. connection was also brought to the top of the tank from the air line and a relief valve provided at the top of the tank. This valve is normally open. When the tank is nearly full of the sludge, the relief valve and the gate valve in the drain are closed. The air is turned on and the sludge is blown out through the outlet in most effective fashion. A water connection is also provided for occasional flushing the tank and the outlet pipe.—*Railway Mechanical Engineer.*

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CURRENT WELDING LITERATURE

SURFACE HARDENING WITH THE OXY-ACETYLENE FLAME, by J. F. Springer—How the oxy-acetylene flame supplies carbon-dioxide to the surface of an iron or steel object—three oxy-acetylene torch adjustments—use of the carbonizing flame—limitations of oxy-acetylene carbonizing—main use of the torch process—experiments on cast steel.—Railway Mechanical Engineer, January.

CARE OF OXYGEN AND ACETYLENE CYLINDERS—Booklet published by the Air Reduction Sales Co., New York, gives instruction for the handling, care and storage of oxygen cylinders—how to use regulators and how to attach them—things to avoid in the handling of cylinders—the importance of returning cylinders promptly—cautions against the use of home-made manifolds. Similar complete instructions are given regarding the handling, care and storage of acetylene cylinders. Marginal notes are used to indicate the text of each paragraph to the reader. The booklet is full of good information and advice for the user of gas and cylinders.

WELDING, CUTTING AND BRAZING PRACTICE, by David Baxter—A discussion of the joining of cast metal—the necessity for an exact knowledge of the nature of the alloy on the part of the operator—the difference of contending successfully with oxidation and methods used to overcome this trouble.—American Garage and Auto Dealer, December.

ARC WELDING OF ALLOY STEELS, by C. J. Holslag—This process is not as easy as it looks because the absolute temperature of the arc is too high for the simple welding of any metal, so in this practice there are methods I use to reduce the temperature. The vaporization of desirable elements is another hindrance which is overcome by changing the composition of the electrode or providing a flux coating, therefore successful methods have been developed for welding common alloys. The alloy nickel electrode has proven the most useful. Several processes have been developed for overcoming the welding difficulties. Especially interesting applications are found in automotive work.—American Machinist, December 20th.

STRESSES IN A FEW WELDED AND RIVETED TANKS TESTED UNDER HYDROSTATIC PRESSURE, by A. H. Stang and T. W. Greene—This technologic paper of the Bureau of Standards No. 243, published by the Department of Commerce and obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10c per copy. It describes the tests made on riveted and electric welded steel tanks for the purpose of ascertaining the relative merits of the two methods of construction. The results of the tests proved rather unsatisfactory after comparing the relative merits of the different joints because of secondary failures. The booklet gives a complete description of the tanks, the test procedure, the theoretical stresses, a discussion of the test results and a summary of the entire procedure. It is illustrated by photographs, drawings and charts.

LARGEST OXY-ACETYLENE WELDED EQUIPMENT EVER BUILT, by R. R. Orwig—Description of the welding, by the oxy-acetylene process, of a rotary carbide kiln 8 ft. in diameter and 125 ft. long. Methods of handling and assembling the material—methods of welding and devices used to take care of expansion and contractions—illustrations of the work in progress and of the actual welds made.—Acetylene Journal, January.

DESIGN AND CONSTRUCTION OF CAST REGULATORS, by E. L. Mills—The purpose of regulators—direct pressure and indirect pressure types of regulators—explanation of the difference between these types in construction and operation versus kinds of diaphragm and material—methods of fastening diaphragm seats—safety devices—grouping regulators—deficiency of standard regulators—a few rules for the benefit of the operator.—Acetylene Journal, January.

HOW WELDING IS USED IN FABRICATING ALUMINUM STEELS, by F. B. Hill—Description of the methods used and results obtained in making several large rosin stills, using the oxy-acetylene torch for closing the joints.—Acetylene Journal, January.

COMPLETED WELDS ARE MUCH SAFER THAN A FEW YEARS AGO, by A. D. Disteen—Attitude of insurance companies is gradually becoming more favorable. They are still interested chiefly in school experiments and conscientiousness of the working welder.—Canadian Welding Journal, December.

PLAN AHEAD IN CAST IRON WELDING, by E. A. Whittaker—A definite method of carrying out the work should be determined upon before the welding is started, as the actual preparation of the cast iron weld is the most important consideration. Charcoal is recommended as the best preheating agent when it is necessary to preheat the whole casting.—Canadian Welding Journal, December.

USE FLAME WITH EXCESS ACETYLENE IN WELDING STELLITE, by Herman Ullmer—Adjustment of the flame—prepare welding temperature—types of welds—torch manipulation—method of completing the weld—the welding of stellite to cast iron.—Canadian Welding Journal, December.

ARC WELDING CAST IRON WITHOUT PREHEATING, by C. J. Holslag—The use of nickel as an electrode in welding. The development of the process since the first use of the electric current from a storage battery to spot nickel into clean cast iron. Further developments laid to the use of an alloy of manganese, copper, iron and nickel. By the use of such an alloy practically continuous welding can be attained.—Machinery, January.

APPLICATIONS OF ARC WELDING TO SHIP CONSTRUCTION, by E. H. Ewertz—Results of tests to determine the strength of welded joints and the attitude of classification societies towards the application of electric welding.—Marine Engineering, January.

THE COST AND PRICE PROBLEM IN OXY-ACETYLENE WORK, by David Baxter—A discussion of the necessity for the good cost system in every welding shop—a sample of the cost card which forms the basis for setting a price on the welded job.—American Blacksmith & Motor Shop, December.

ELECTRIC WELDING OF CAST IRON—The use of the carbon arc follows somewhat the same procedure as the oxy-acetylene method of welding castings. Preheating is usually necessary and care must be taken to avoid adding too much metal in one place. This method has the advantage of allowing the operator to use a filler rod of cast iron. Slow cooling is recommended. The metallic arc method can be accomplished with or without studs. Preheating is usually not required. Some authorities recommend the use of reversed polarity.—Acetylene & Welding Journal, London, December.

OXY-ACETYLENE WELDING OF CAST IRON—The influence of mass on expansion and contraction problems. Description of the method of welding a heavy casting which avoids manipulation of the casting in the fire and keeps the welded portions at identical temperatures at all periods of the welding operation.—Acetylene & Welding Journal, London, December.

ARC WELDED RAIL BONDS, by C. F. Gailor—History of the development of electric arc welding copper bonds to steel bonds—character of the bonds—use of molds—use of the carbon arc—use of the metallic arc—process of applying bonds to the head of the rail—procedure in applying Weber type bonds—procedure in applying base bonds—mechanical tests—electrical tests—miscellaneous tests.—Journal of the A. W. S., December.

WELDED RAIL BONDS, by H. H. Febrey—Application of copper bonds to steel rails by the oxy-acetylene process. Early discovery that copper as a welding rod produced poor results. The advantage of the frame welding process in new construction and in high clutch trolley systems. Developments of arc welded bonds.—Journal of the A. W. S., December.

A RESUME OF THE RESISTANCE WELDING DEVELOPMENTS FOR THE PRESENT YEAR, by H. A. Woofter—Brief discussion of the latest developments in spot welding and butt welding.—Journal of the A. W. S., December.

FLUX AND OTHER FUNCTIONS IN ELECTRIC ARC WELDING, by J. Caldwell—Character of the weld—flux in steel manufacture—flux and other functions in arc welding—flux covered electrodes for arc welding.—Journal of the A. W. S., December.

FRAME WELDING, by A. F. Dillon—Discussion of the modern methods of repairing locomotive frames by the oxy-acetylene process—common causes of failures—the use of spreaders to secure expansion—welding procedure—cost table.—Journal of the A. W. S., December.

SOME MANAGEMENT PROBLEMS ON PIPE WELDING JOBS, by G. O. Carter—The difficulty of organizing efficient welding crews and how this organization has been accomplished by the Prairie Pipe Line Co.—management problems in connection with the welding of steam pipe—the importance of getting the manager to follow the best welding principles.—Journal of the A. W. S., December.

ARC WELDING AND CUTTING ECONOMIES, by A. M. Candy—Specific examples of economy and advantages in connection with the fabrication of steel structures and the manufacture of metal products as well as in the repair of railroad and industrial equipment.—Industrial Engineer, January.

WELDING IN LOCOMOTIVE REPAIR SHOPS, by Fred E. Rogers—Various oxy-acetylene welding operations employed in locomotive repair work—frames, cylinders, piston rods, wheel centers—wheel center spokes—pipes—tires—pilot beams—transoms, etc. Need for careful supervision—service rendered by manufacturers of gas and apparatus.—Railway Locomotive Engineer, December.

ARC WELDING AND CUTTING ECONOMIES, by A. M. Candy—Specific examples of economy and advantages in connection with the fabrication of steel structure and the manufacture of metal products as well as in the repair of railroad and industrial equipment—Industrial Engineer, January.

AUTOGENOUS WELDING AND THE CONSTRUCTION OF AUTOMOBILES AND AEROPLANES—An account of several important applications of welding in these industries on production work.—Revue de la Soudure Autogene, Paris, November.

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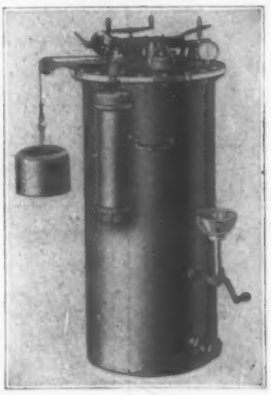

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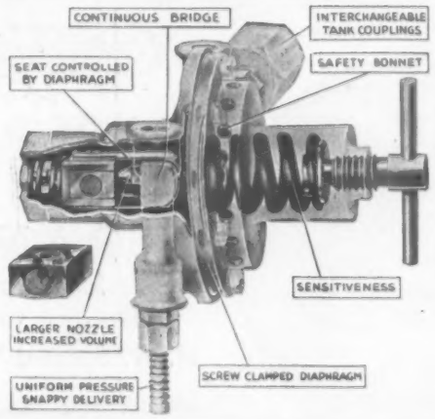

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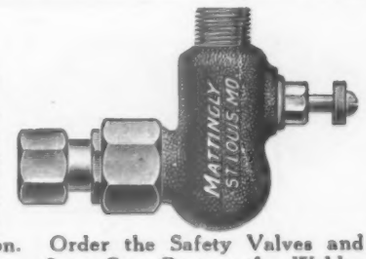

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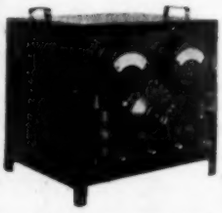

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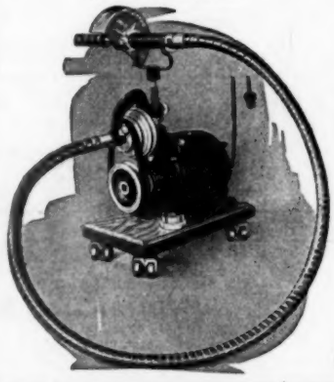

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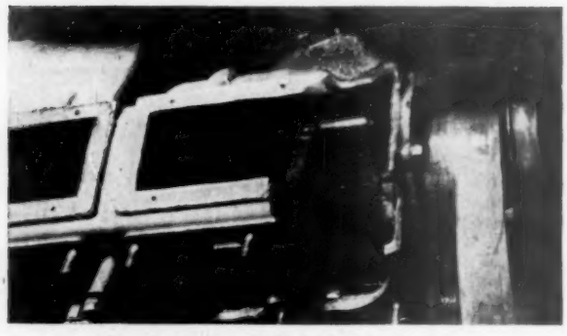

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